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Contents.

	PAGE
Forthcoming Events	245
Presidential Addresses	245
Ethical Buying	245
Correspondence	246
Reconstruction of a Blast Furnace	246
Random Shots	246
Industrial Russia of 1932	247
The Ottawa Agreements	248
Examinations in Foundry Practice and Pattern-making	248
Constant Weight Cupola Blowers	249
Some Observations on the Character of Cast Iron	250
The Size of the Iron Foundry Industry	253
Price Cutting	255
This Week's News in Brief	258
Trade Talk	258
Company Reports	258
Personal	258
Obituary	258
Raw Material Markets	260

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Foundry Technical Institute, Meek's Road, Falkirk (Telephone 332).

Forthcoming Events.

NOVEMBER 3.

Institute of Metals (Sheffield Local Section):—Ordinary meeting. "Nickel-Silver Alloys for the Electro-plate Trades," Paper by W. R. Barclay, O.B.E.

Institute of British Foundrymen.

OCTOBER 28.

Middlesbrough Branch:—Ordinary meeting. "Some Aspects of Jobbing Moulding, with some Gating Suggestions," Paper by S. Southcott.

NOVEMBER 4.

Birmingham and Coventry and West Midlands Branch:—Ordinary meeting in Birmingham. "Properties of Pig-iron," Paper by J. E. Hurst.

Lancashire Branch (Preston Section):—Ordinary meeting. "Source and Elimination of Blowholes, Cracks and Drawn Holes," Paper by C. H. Kain.

Presidential Addresses.

The tradition that the newly-elected President of a technical or scientific society should deliver an inaugural address is based on sound reasoning, for a President is usually elected to that office by virtue of special gifts, and it frequently offers the opportunity of a lifetime for presenting to the industry the reflections and conclusions derived from many years of experience, and which can be given in no other way. We have not, as a rule, felt so sure of the wisdom of encouraging Branch-Presidents, in the case of a body like the Institute of British Foundrymen, or the chairmen of local sections in the case of other metallurgical societies, to follow this precedent, and we rather welcome the practice in which the President contents himself with a brief introductory address, leaving the major portion of the evening free for the reading and discussion of a suitable technical or practical Paper. At the present time it means that there is a spate of presidential addresses, and we are not at all certain how far they are read throughout the trade.

In one respect, however, they serve a very useful purpose. Throughout a number of addresses both this year and in previous years it is possible to see the same subject brought up over and over again, and discussed from various angles, and it thus becomes possible to discern those major questions which agitate the minds of foundrymen as a whole, and on which, therefore, some action is bound to be taken sooner or later. The repetition serves to impress even the least observant member of the trade that something needs to be dealt with. Among these questions is the one of education, that is, of practical training and technical knowledge. Others concern such matters as costing, cut-throat competition, surplus capacity, rationalisation, and so on, which can only really be dealt with by a strong federation of makers' associations.

The extent to which the industry suffers is well illustrated in the statistics furnished in Mr. Pearce's address to the Birmingham, Coventry and West Midlands Branch. He points out the discrepancy in the figures for the number of foundries given in the official census of production figures published last January for the year 1930 and the number of foundries which most men in the trade believe to exist. The discrepancy is about three to one. It cannot be said that this is satisfactory. On a basis of value it is pointed out that the discrepancy is materially less, so that it is evident that it arises to some extent from the fact that the census ignores the small foundries. Nobody can pretend that this fully explains the difference. Doubtless, however, information will become available which will give us more accurate figures to work on.

Ethical Buying.

The evils of price cutting has been stressed in several of this year's presidential addresses that one's thoughts are immediately directed into the channel of the actual buyer. It should be remembered that foundries buy as well as sell—in fact, they are one of the greatest buyers of raw materials in industry. We make constant contact with people who are selling to the foundry industry, and they, too, report the existence of cut-throat competition due to the action of the buyers. Thus, immediately one encounters the existence of a vicious circle. Because buyers of castings are "squeezing" the foundry, the foundry "buyer" passes on the squeeze to the supplies of pig-iron, coke and other raw materials. If the founders could ameliorate somewhat the "squeeze" exerted by their own buyers they would find a fair reaction, as, after all, mines, coke ovens and blast-furnace plants are very important buyers of castings. There are certain sections of the industry, such as those making municipal castings, which have nothing left to give away, whilst the builders' castings industry is being handicapped by the stupidity of one or two firms only. There are, however, several branches of the industry which need not exert undue pressure in their buying departments, as, for instance, where the major portion of the costs is debitable to labour and not to materials. To our mind it is futile for foundrymen to grumble about the unethical buying of their products when they themselves do little or nothing to ensure that their own purchases are on a different plane. Foundrymen should do all they can to ensure that their firms join their respective employers' federation, because when they meet periodically opportunities do arise for the elimination of at least the worst type of unethical selling.

C

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

A Proposed Foundry Technical College.

To the Editor of The Foundry Trade Journal.

Sir,—As one who is greatly interested in foundry education, I have studied with great interest the article by Mr. V. C. Faulkner on a proposed foundry technical college which appeared in your issue of October 6.

The interest of the Paper has been tempered by the knowledge that unless the sincerity of the author be known to the reader much harm can be done in quarters who are interested and are being interested in foundry education. In particular the condemnation of the majority of the Universities with metallurgical courses as being unsuitable by tradition or by the character of the professional chair is hardly the method which will appeal to those who are striving to get the foundry side of practical metallurgy into a more prominent place in the teaching curricula.

Whilst congratulating, without comment, Birmingham and Manchester as Mr. Faulkner's choice for the proposed school, I believe the writer of the article would have not so summarily dismissed Sheffield from his final consideration if he had been more alive to certain facts. The Sheffield area produces the most steel castings, and the greatest weight of iron castings of any district in the British Isles whilst the non-ferrous foundries are numerous and varied in their products.

The School of Metallurgy at Sheffield was founded by John Oliver Arnold, F.R.S., and among his students have been Dr. W. H. Hatfield, the late H. C. Dews, Past-Presidents of the I.B.F. in Dr. Longmuir and Mr. Faulkner himself, the present President of the I.B.F., Mr. V. Stobie, as well as many others prominent or otherwise in the foundry industry. Arnold equipped the University with a foundry complete with every type of melting equipment for steel, iron and non-ferrous metals.

Prof. C. H. Desch, F.R.S., succeeded Arnold, and his interest in the foundry industry may be shown in many directions, of which the following are a few examples. He was elected to the presidency of the Sheffield Branch of the I.B.F. in 1924-25. Prof. Desch was largely responsible in conjunction with local employers and educational authorities for a scheme whereby foundry apprentices, etc., received part-time education at a primary technical school followed by part-time study at the University. This scheme, although widely advertised, has been received with apathy.

Prof. Desch has been largely responsible also for the growth of the Trades Technical Societies for the education of managers and employees in the Sheffield trades. The foundry classes have always enrolled over 30 students annually, and last year the University altered the syllabus so that the class could if they wished sit for the Foundry Certificate of the City and Guilds Examination. Fifteen members of the class elected to do so, and ten passed, five in the first class.

Prof. J. H. Andrew took over the Chair of Metallurgy this year, and his interest in the foundry education has early been shown in the extension of practical classes and the provision of further equipment. The unsatisfactory nature of the City and Guilds Examination has led to the consideration of the possibility of the issue of certificates with some practical backing, of a possible Associateship in Foundry Practice, and even as a future probability the sub-division of the B.Met. degree to take care of the foundry side of metallurgical operations. That is the position at Sheffield University to-day, and one which for any University I believe is hardly as nebulous as the leader writer in your Journal would have his readers believe.

The future of the educational facilities for foundry work does not depend at Sheffield University on the financial side alone. The Metallurgical School was built up by Arnold under conditions which were very much more difficult than those appertaining to-day. The position of Sheffield may be summarised that if sufficient interest could be aroused for students to apply for courses in foundry metallurgy and practice the University would make every effort to meet the demand both as regards staff and further equipment. The trouble is that the foundry industry is either unaware of the benificent traits of Universities or, more probably, thinks it has little to learn.

In conclusion, may I state that I am not a member of the staff of Sheffield University, and not even a member of it, and that I have written this letter in order to show that at one place a group of individuals have done, and are still doing, something to bring about a proposed technical college for foundry training even if the efforts are not worthy of Mr. Faulkner's commendation. But there is always an excuse for Mr. Faulkner, for being a Sheffielder himself he cannot be expected to know much about what goes on in his native town!—Yours, etc.,

J. G. A. Skerl, D.Sc. (Lond.).

Sheffield,
October 17, 1932.

Reconstruction of a Blast Furnace.

MODERN IMPROVEMENTS INCREASE EFFICIENCY.

The Wheeling Steel Corporation of the United States have reconstructed recently a blast furnace originally built in 1916-17. The improvements include new gas-cleaning equipment, a sludge recovery system, zoned hot-blast stove linings, electric mud gun, air-mixing equipment and a selective stock revolving distributor.

Reconstruction of the furnace below the mantle consisted of installing a new cast-iron water-cooled hearth 9 ft. deep by 23 ft. 4 in. internal dia. by 6 in. thick, made up of 12 water-cooled segments bolted together and reinforced by two heavy circular bands on the outside. A new tuyere jacket 1½ in. thick by 7 ft. 7½ in. deep by 23 ft. 4 in. internal diameter was furnished, and five new bosh bands 1¼ in. thick with varying diameters to suit the bosh angle also were provided.

The original top construction, comprising low baffled-type uptakes and downcomers, was replaced with four modern-type uptakes and downcomers, and two new air-cooled bleeder valves were added. A new cone ring which connects the shell to the cast-steel seat ring, as well as a large bell and hopper, were other additions to the furnace. A complete new brick lining was installed, with 14 rows of removable bronze cooling plates set in the brickwork above the mantle, and complete new extra-heavy water piping supplied for connecting up the entire cooling system.

The old dust-catcher was changed to a straight cylindrical shell so as to increase both its capacity and efficiency. Following the dust-catcher was a Brassert-type 15-ft. dia. gas washer which was reconstructed. New sludge-recovery pits also were installed. Immediately behind the washer is provided a low-power Brassert-type disintegrator of 40,000 cub ft. per min. capacity followed by a moisture eliminator reconstructed from the old horizontal dryer. The disintegrator is arranged to float on the gas line.

Two new 24- by 100-ft. hot-blast stove linings of the Brassert high-efficiency zoned type, with heavy insulation, were installed. The stoves were provided with a Vincent-type air mixer, the mixer air being put in the combustion chamber ahead of the hot-blast valves, which

(Concluded from previous column.)

results in equal temperature distribution of air at all tuyeres and protects the hot-blast valves against high temperatures. A regulator was installed for automatically controlling the hot-blast temperature within close limits. Messrs. H. A. Brassert & Company, Limited, were responsible for the design and entire reconstruction of the plant.

Random Shots.

One of the things that statisticians have not yet turned their attention to, as far as "Marksman" is aware, is the holding of conventions. In this country Convention Season seems to begin in May and tail off about October, with June, July and September as the peak months. Nobody has yet produced graphs of the number of conventions held annually, and pointed out that, in comparison with pre-war years, we have managed to increase our yearly convention production by such and such a percentage. Nor has anyone attempted to plot seasonal variations, saying that "whereas in 1923 there were twelve conferences held in June and nineteen in September, in 1930 eighteen were held in June and only seven in September. From these figures it would appear that there is a tendency to favour the warmer months of the year for the purpose of staging conferences. And so on, *ad infinitum*.

* * *

One of the bodies that do not favour the warmer months, however, is the National Food Canning Council, which is holding its sixth annual convention in Birmingham this week. The reason for this is obvious. Our canneries are working at high pressure during the summer months, when the fresh fruit is available, and do not begin to slack off until towards the end of September. Moreover, the number of executives in an average canning factory is small, and they certainly couldn't afford the time to attend a conference in, say, June.

* * *

A number of readers have written asking for news of Miss Nellie Snookers. Their interest is touching. As a matter of fact, "Marksman" has not visited the Gayway Foundry recently; his visits to Eastbourne decrease with the hours of sunshine. He learns from Miss Snookers, however, that she has in hand several interesting novelties. Foremost amongst these is a patented chestnut and potato roaster. To quote from her letter of a few days ago: "The chestnut and potato roasters one sees in the streets to-day are terribly inefficient contraptions, and therefore I have designed a roaster on scientific lines which will consume less coke at the same time allowing of much better roasting. Production is now well in hand. The roasters themselves are of grey cast iron, vitreous-enamelled a bright red. The Gayway Foundry has contracted with a neighbouring firm of woodworkers to supply the barrows, and the complete roasting unit can be marketed at a very moderate figure. If trade gets very much worse this winter, there should be, I imagine, an enormous demand for these roasters. In view of this I am planning the addition of another bay to the Gayway works. If you or any of your friends should want a roaster within the next few weeks I can arrange to supply them at a discount of 25 per cent. off the list price. Yours sincerely, N.S."

* * *

A young Italian immigrant and his wife had just landed in New York. While walking down the street they were startled to see a fire engine go racing by, with flame and smoke pouring forth from the funnel. The Italian eyed the departing monster for a moment, turned to his wife, and said: "Looka, Rosa, that's the kinda of peanut roaster we hava some day."

"Marksman."

Industrial Russia of 1932.

IRON AND STEEL WORKS.

By Percy Fox-Allin (Associate Editor).

In the lay-out and equipment of the iron and steel works the Soviet have displayed the same feverish and uneconomic haste which is so characteristic of their industrial development generally. They would have been better advised had they conserved the capital which they have expended upon extensive development until such time as they had bought their experience in the operation of a modern works.

Granted that one large works properly managed should prove more economical than two or more small works, these require really big men at the head of the administration, and there is a dearth of such men in Soviet Russia to-day. In pre-revolution days Russia certainly had her quota of clever and capable engineers, but for reasons into which it is not necessary to enter, very few of those men remain in Russia to-day. Further, it would seem that the Soviet Government have shown too great a haste to dispense with the services of the foreign experts, though for the most part such experts were not employed in administrative capacities, but rather on processes. It is, of course, essential to have the various processes under the management of experts, but that in itself will not secure efficiency. The administration of the works must be capable not only of getting the best out of the several experts, but must possess the ability to keep the processes in balance and to weld them into a harmonious whole.

The industrial programme drawn up by the Soviet would have been difficult to put into operation even in a country peopled with skilled workman, but it might have been evident it was wholly impossible in Russia. However, the Five-Year Plan was formulated, and apparently it had to be carried out regardless of commercial considerations, and surely with small chance of any initial efficiency. It must be admitted that the iron and steel works in point of design and equipment are well in line with modern ideas, and there is little doubt that they are capable of giving the outputs claimed for them; it is, however, quite certain such outputs are not being obtained, only under exceptional conditions.

Blast-Furnace Plants.

Russia is, of course, a very old iron-producing country, indeed in the 18th century large quantities of pig-iron were exported from the Urals, Great Britain being perhaps the largest importer. At this time the whole of the iron was smelted with charcoal and the ample supplies of wood available for the making of charcoal placed the Urals at a distinct advantage. With the introduction of coke, however, came the decline of the Urals and the development of the iron industry of the Ukraine with supplies of coking coals from the Donetz Basin. There are still blast-furnace plants working with charcoal in the Urals and in order to meet the demands for high-speed steels, such plants will no doubt be reconstructed and extended. The Urals will thus become the centre of production for high-speed steels in the U.S.S.R.

Assuming that the output can be brought into line with the capacity of the plant, the blast furnaces of the Urals will produce approximately one-third of the pig-iron manufactured in the U.S.S.R.

The Magnitogorsk Plant.

The principal works are the much-discussed Magnitogorsk, the initial lay-out of which provides for the erection of four blast furnaces each to produce 1,000 tons of pig-iron per day. Provision is to be made for extensions which will bring up the output possibilities to 4,000,000 tons per year, and the Kuznetsk plant is planned to produce 1,200,000 tons of pig-iron per year. On the face of it the disposition of these two works is very well conceived, the Magnitogorsk plant being situated in the midst of the ore-fields of Mount Magnitnaya and the Kuznetsk plant in the heart of the Siberian coal-fields, so that the freight trains bringing coal and coke to the first-named will return loaded with ore to Kuzbas. Very radical changes will, however, have to be made in transport facilities if this arrangement is to work with any degree of smoothness and efficiency. For the time being it is certainly not doing so, whilst there are at present two blast furnaces at each of the specified works in operation. It is quite true that upon one day, August 7 last, the No. 2 furnace at Magnitogorsk brought down 1,094 tons of iron, but the output of a furnace must be the average over a period, and the average of the furnaces in question has hitherto been something like 500 tons per day. This restricted output is possibly due in equal measure to failure in delivery of raw materials and careless charging and working, this last being responsible for a number of blow-outs. Yet this plant in its entirety, assuming that the present plans are carried out in full, will produce an output approximately equivalent to half the total amount of pig-iron produced in Great Britain.

Steelworks.

The plans for the steelworks, the construction of the first portion of which is in progress, are no less ambitious, providing in the first place for 28 Siemens open-hearth furnaces each of a capacity of 150 tons. In the rolling-mill it is proposed to install three cogging mills, each capable of cogging down 900,000 tons of ingots per annum. The first of these mills, built in Russia, is in course of erection. Other mills specified are nine merchant and bar mills and a heavy rail and girder mill. In this, as in every other industrial undertaking in Soviet Russia, a great deal of the work is carried out by the so-called "Shock Brigades." Generally, workers in Russia are supposed to have one day in five free for recreation; they are, however—to express it nicely—allowed to volunteer to devote that day to assist in the furtherance of work in a branch of activities outside their daily occupation which is assumed to be behind programme. For meritorious services in this direction the usual reward is the "Red Banner," and more rarely money premiums.

Developments in the Ukraine.

In the Ukraine equally intensive methods for the development of the iron and steel industry have been adopted, though for the most part the reconstruction is not so far advanced as the developments in the Urals. Some idea of the magnitude of the work in hand may be gathered from the following: The Tomsky works at Mekeyefka, which in 1929 produced 221,000 tons of pig-iron, will, when the reconstruction is complete, have an output capacity of about 1½ million tons. The capacity of the Voroshilov furnaces is to be raised, by reconstruction, from an output capacity of 217,000 tons to 972,000 tons, whilst the Dzershinsky furnaces at Kemenskoye, formerly producing about half-a-million tons per annum, are being reconstructed for an annual output of 1,900,000 tons. As a matter of fact six of the reconstructed furnaces have been blown in at these three works for which a total output capacity of 1,700,000 tons per annum is claimed.

This enormous possible increase in production brought about by a wholesale scheme of reconstruction was not in itself sufficient to satisfy the immediate ambitions of the Soviet, for they are at the same time embarking on the building of new plants of even greater proportions. Outstanding amongst these new undertakings is the plant of the Dniepro Combine at Zeporozhye, which provides for the ultimate erection of eight blast furnaces, each of a capacity of 1,000 tons per day. The building of this works was commenced in 1930. The first two furnaces are complete, and it is said they will be blown in at the latter part of this year, whilst the second two furnaces required to complete the first portion of the plant are in an advanced stage of construction.

The Asovastal works, which was also commenced in 1930, is being laid down to produce 1,000,000 tons of pig-iron per annum, whilst a further, actually the third, works at Krivoirog, the building of which was commenced in 1930, is being designed for an output of 1,200,000 tons of pig-iron per year. At each of these works steel furnaces and rolling mills are to be erected, and, in fact, producing their own coke, it is the intention to make them self-contained.

We have given the outputs for which the several plants were designed, and, as foreign engineers were responsible for those designs and were also in charge of the building, there is little doubt that the furnaces themselves would, if properly handled, give the outputs claimed; but, as the writer has already said, works of such magnitude call for efficient administration and skilful management. The Soviet authorities appear to have considerable difficulty in finding men sufficiently capable for either duty within her own domain, whilst at the same time they show little disposition to place the real administration of those works in the capable hands of her foreign advisers. Further than this, it is wholly impossible to run such works on economic lines without highly-efficient transport facilities, and until such facilities are provided, every producing works cannot be other than heavily handicapped.

Speeding up Production.

With a view to speeding up production, a three-months' blast-furnace contest was promoted by the People's Commissariat of Heavy Industry and the Metal Workers' Union, and, needless to say, practically the whole of the works have entered into the contest. Apparently the contest is to be determined purely upon the tonnage output; cost per ton does not seem to enter into the calculation, though at least one works seem to display a little regard to productive costs, as their plan provides for keeping the consumption of coke down to 0.9 ton per ton of iron cast. Presumably there is no limit to the amount of labour which may be called into service, for one finds works setting aside sums of 10,000 roubles to be paid out in premiums to "shock" workers and at practically every works entering the competition allocations of moneys have been made for a similar purpose. In no other country in the world would it be possible to organise such competitions, because in Russia alone exists the necessary industrial conditions, including the peculiar mentality of the workers. The competitions are not confined to rivalry between works engaged in similar activities, but they are conducted within the individual works. Thus, at the Leningrad rubber works, boards displaying in prominent positions gave the number of pairs of boots completed by the individual shifts, and there is no doubt whatever that the fostering of such rivalry is responsible for increased effort on the part of the individual worker.

There is still an urge and an unmistakable enthusiasm amongst the majority of the workers. It is impossible to foretell what may happen when the urge is gone and enthusiasm wanes. The real problem seems to be whether the Soviet will be able to maintain that urge and enthusiasm amongst the vast body of its workers under the existing conditions of living and until such time

(*Concluded on page 260.*)

The Ottawa Agreements.

VIEWS OF PROMINENT INDUSTRIALISTS.

We publish below a number of communications from prominent industrialists who, at our request, have kindly consented to express for the benefit of our readers their views on the Ottawa Agreements.

Sir William J. Larke, K.B.E. *(Director of the National Federation of Iron and Steel Manufacturers).*

In my view the Ottawa Agreements cannot fail to operate to the very great advantage of the British iron and steel industry, in increasing the market for British products in the Dominions. In most of the Dominions the agreements provide increased opportunities, by reduction in tariffs and removal of restrictions on the import of British iron and steel. In Canada, for example, not less than 40 iron and steel tariff items have received increased preference in favour of British against foreign competitors; of these 25 are an increased preference, either by reducing the duty on British goods or increasing the intermediate and general duties; and in 15 cases free entry has been granted to British products.

In the case of India the principle of preference has been established, and increased preferences have been granted to British iron and steel products. There are conditions attaching to these preferences which, however, involve co-operation between the British and Indian iron and steel industries in their mutual interest; and I anticipate that agreement will be reached on details which will operate to their mutual advantage.

In Australia and New Zealand, where the British industry already supply the major portion of the imports, the British preferential position has been improved. In the case of Australia it is hoped that the British and Australian industries may be able to develop a policy of co-operation in Australia and markets accessible thereto.

Much more important than the immediate quantitative results is the spirit in which the Conference was conducted, and the relations that have been established with representatives of other Dominions, notably in Canada, where they were able to meet their fellow-industrialists; this will prove invaluable in the future. The discussions were conducted in an atmosphere of the greatest cordiality and complete candour, which should lay a firm foundation for future co-operative action.

Mr. Charles Mitchell *(Chairman, Dorman, Long & Company, Limited).*

The Ottawa Agreements will be welcomed by the steel industry as a step in the right direction. Their influence will be felt immediately in our trade with Canada, and the principles upon which they have been framed should later lead to an increase of trade with other Dominions.

There is always a tendency in countries with high protective tariffs to encourage the production of particular products for which the local demand is insufficient to allow of economic manufacture. Co-operation between the home steel industry and the steel industries that have been established in certain of the Dominions will result in complementary production to the advantage of the home country and to the benefit of the consumer in the Dominions, whilst the Dominions will be given compensating advantages by means of a preferential tariff over here for other products which they are more eminently suited to supply. There is no doubt also that the increased preference extended to us by the Dominions and Colonies will divert to British works orders hitherto supplied from foreign sources.

It must not be supposed that the benefits of the Ottawa Agreements will be obtained without effort on the part of the British steel industry; steps for the development of the Canadian market had indeed been taken some time prior to the Conference, but there is no doubt that Ottawa has given an additional stimulus to such work, and that extensions of the policy that has been followed with regard to Canada may be expected in the other Dominions.

Coming at the moment when the industry, as everyone knows, is in the process of an internal re-organisation, designed to enable it to sell the right product at the right price, the Ottawa Agreements are particularly encouraging and opportune.

Mr. L. D. Whitehead *(Chairman and Managing Director of the Whitehead Iron and Steel Company, Limited).*

The main value arising out of the Ottawa Conference is that it does further establish and expand the principle of preferential trading between the various units of the Empire.

Undoubtedly the various agreements entered into with Canada, Australia, New Zealand, India and South Africa will very greatly influence trade in the direction of this country. The steel trade—thanks to the fine work put in by its delegation both at and before the Conference—stands to gain as much as any industry.

It is possible that in the present abnormal conditions of trade some of our foreign competitors will be disinclined to give up the business they formerly held, and attempt to "jump" the increase in tariffs. Once, however, more normal conditions prevail, the benefits of the present agreements will become more apparent, and the principle of preferential trading will be further expanded.

One of the great benefits of the Conference has been that the various discussions which have taken place have brought the industries of this country into closer contact with the industries of the Dominions than hitherto, and in this respect there is great hope for the very closest co-operation in future, to our mutual benefit.

Sir Arthur Balfour, Bart., K.B.E., J.P. *(Chairman and Managing Director, Alfred Balfour & Company, Limited).*

Regarded from the point of view of general atmosphere, there is no question at all that Ottawa has done much to bind together and make the different parts of the Empire understand one another better. When you come to the concrete advantages which have been obtained by the iron and steel trade, I think Mr. A. J. Grant and Sir William Locke and their colleagues are very much to be congratulated, for not only have they carried on their negotiations with great skill and pertinacity, but they have certainly established most friendly relations with the iron and steel manufacturers of Canada and obtained for this country substantial advantages.

When you come to the tool trade, the reduction of the duty from 15 per cent. to 10 per cent. is, of course, very welcome, but, taking files as an example, it seems not equitable that Great Britain should have to pay 10 per cent. for files going into Canada when we are allowing files made in Canada to come into this country free of all duty on account of Imperial Preference. There ought to be complete reciprocity; still the steps that have already been taken are on the way to this, and, looked at as a whole, if properly followed up by us, there are very substantial advantages for the British trader and equally so for the sale of Canadian primary products here.

It must not be lost sight of, this is the first time that an Imperial Conference has been held away from London, and the experiment must be definitely counted as a success.

Mr. J. D. Brunton, O.B.E. *(Director, Bruntons (Musselburgh), Limited).*

No doubt it is a great adventure, and the lessons which will be learnt in a few years' practical working of the agreement will certainly be worth a lot of talk. Whether it will actually benefit the wire and wire-rope industry in this country remains to be seen. If the Conference and agreements benefit any trade it will no doubt be reflected on others, and may be the means of starting the ball rolling.

I have always held the opinion that our Empire should pay the most attention to the primary industry in the particular part of the world in which it is situated, and should protect these industries in every possible way and not sacrifice them to boost up their secondary industries which seems to have been the case of late years. Our geographical position, as far as Canada is concerned, is against us, more particularly in our class of trade, as it is so easy for a Canadian buyer to ring up on the telephone a supplier in the States and get delivery of what he wants within a day or two. He therefore has not to keep so much stock in hand, and he has not to anticipate his wants so far in advance, and when he comes to buy now he will have to put this advantage against the cheaper price. In addition to this, the States, when receiving the inquiry can, as a rule, have someone on the door step of the office from which the inquiry has emanated in a couple of days, and a personal interview very often is the means of securing the order. There is, however, a very considerable tonnage which could be sent from this country, which can be anticipated, and I hope that the agreement and the cheaper prices which can be obtained will influence the buyer to place his business in the Empire.

Mr. W. R. Lysaght *(Chairman, John Lysaght, Limited).*

As far as I can see at present the results of the Ottawa Conference will be distinctly helpful to the iron and steel industry of this country.

Canada's attitude shows that she is determined to foster trade with the Empire, and we should be grateful for what she has done.

India's suggestions are encouraging. It is too early yet to express an opinion of Australian and South African policies.

Examinations in Foundry Practice and Patternmaking.

The first series of examinations conducted by the City and Guilds of London Institute, under the new syllabus arranged by the Institute in conjunction with the Institute of British Foundrymen was held in April last. The results which have just been announced show that in the subject of Foundry Practice and Science 50 candidates submitted themselves for examination, there were 10 first-class passes and 21 second-class passes and 19 failures, the percentage of passes being 62. There was also a candidate from India who was awarded a first-class pass. The highest marks in the examination were gained by Mr. T. R. Walker, B.Sc., hon. secretary of the Sheffield Branch of the Institute of British Foundrymen, who was awarded the City and Guilds of London Institute Bronze Medal.

In the subject of Patternmaking there were eight candidates in the Final Grade, one of whom passed first-class and two second-class, the percentage of passes being 37.5. The first place in this grade was gained by Mr. G. K. Simpson, of Rugby, who was awarded the City and Guilds Silver Medal. In the Intermediate Grade, Patternmaking, there were 15 candidates, of whom three passed first-class and four second-class; the percentage of passes was 46.7 The first place was gained by Mr. J. G. Rees, of Sheffield, who was also awarded City and Guilds Bronze Medal.

Constant Weight Cupola Blowers.

The British Thomson-Houston Company, Limited, has recently developed a new cupola-blowing equipment which greatly improves the efficiency of the melting operation. In the past, cupolas have been operated either on the basis of holding a constant wind-box pressure or supplying a constant volume of air. The new method involves the supplying of a constant weight of air. To obtain the highest efficiency in operation of the cupola, it is necessary to utilise the maximum heat units available from the burning coke, and therefore the union of the oxygen of the air and the carbon of the coke makes the problem of the air supply to the cupola a very important one, a point which has not been generally appreciated.

The three chief variables are the iron, coke and air. Nearly all foundrymen use scales for weighing the coke and iron, and it is just as essential that the air be supplied by weight, too, but prior to the introduction of the constant-weight cupola blower with automatic control, it was not possible to provide the air in this manner, and the air quantity delivered to the cupola was very often a matter of guesswork.

Fig. 1.—Constant Weight Cupola Blower, 5,300 cub. ft. per min., complete with Driving Motor and Automatic Blast Gate Valve. The Control Gear is Seen on Right.

By using the constant-weight cupola blower, with its automatic control, it is possible for the foundryman to determine the correct weight of air, after which the apparatus may be set to supply automatically a constant weight of air, irrespective of the changes in the temperature of the air, barometric pressure or varying resistance through the cupola.

Since a unit volume or air changes considerably with atmospheric conditions, and especially with the temperature of the air, it follows that cupola blowers should give constant weight and not constant volume. Furthermore, a blower that can be operated to give a varying volume between minimum and maximum requirements whilst maintaining the weight of air constant should be used.

Necessary Plant.

The equipment consists of a single-stage blower driven by a motor running at substantially constant speed, an automatically-controlled blast gate valve, and a control panel. The inherent characteristics of the blower are such that the control panel will automatically operate the blast-gate valve, so that a constant weight of air is delivered to the cupola irrespective of atmospheric conditions, or resistance through the cupola.

The control equipment operates on the principle that a blower and motor of suitable type have such characteristics that a constant weight of air will be delivered if the electrical input to the motor is kept constant. This is done by automatically adjusting the blast-gate valve, which provides an artificial restriction in the discharge pipe to the cupola. The cupola pressure will vary, depending on the operating conditions, and accordingly the blower is designed for a pressure slightly higher than that needed for average operation, the difference being throttled by means of the gate valve. Then, if atmospheric conditions, density of the coke or iron, changed conditions of the tuyere, or any other cause tends to increase or decrease the weight of air supply so as to change the input to the motor, the flow can be restored by regulation of the blast-gate valve.

Control Equipment.

As the apparatus is actuated primarily by the power input to the motor, and since the voltage is reasonably constant in most cases, the current reading in amperes varies directly with the kilowatts input. This "ampere" reading may, therefore, be used in most cases instead of the "kilowatts" reading. The automatic control equipment, seen on the right in Fig. 1, consists of a reversing motor geared to a blast-gate valve through a high gear ratio and provided with limit switches to prevent the valve from over-travelling.

On the left of Fig. 2 is shown the pillar containing the automatic weight-control panel, with the door open in order to reveal the contact-making ammeter, switch and fuse, regulating rheostats and two standard contactors. When the current increases slightly, contact is made, and the circuit is completed through one of the contactor coils, the contactor closes and supplies power to the small motor, causing it to run in the correct direction to close the valve, restoring the amperes required to normal again. Similarly, when the current falls slightly, the other contactor closes, causing the motor to run in the other direction, thereby opening the valve and bringing the current up to normal again.

An auxiliary relay is energised all the time the blower motor is running, and power for operating the panel is supplied through its contacts. When the blower is shut down at the end of the heat, this relay closes the power circuit to the panel so that power flows direct to the closing contactor, and the valve moves to the closed position, and the limit switch on the gate breaks the circuit. This means that the valve is always in the closed position at starting, which gives the best starting condition, and also serves to close the valve automatically and to restrict the flow of gas from the cupola to the pipe line.

How Variation is Assured.

The rheostats are used to vary the setting of the control point of the ammeter so that any desired value of 1 lb. of air can be maintained within the limits of the blower, which are approximately from 40 per cent. of normal load to 20 per cent. overload. The contact-making ammeter arm is adjusted to the horizontal position by screws and a spring, and for a given current corresponding to the normal current on the machine, with the rheostat in approximately mid-position and in parallel with the coil on the contact-making ammeter, the arm will float in this position with both contacts open.

If the current or lb. of air value is to be increased, some of the resistance is cut out, allowing more current to flow through the rheostat and less through the current coil. This causes one of the contacts on the arm to close, and the valve is opened wider, increasing the flow of air. The increased flow of air increases the current to a value which causes the contact to open, and the arm returns to the horizontal position. The new value of current, and the corresponding new weight of air, are shown on the indicating ammeter, which may be seen mounted on top of the control pillar in Fig. 2.

To reduce the weight of air, the rheostat handle is turned to increase the resistance. This causes the other contact on the arm to close, and the valve closes and reduces the weight of air to the lower value required. The equipment is made of standard parts, properly enclosed, and requires no attention other than oiling of the small motor and gears, probably once or twice a year.

Constructional Details of Blower.

Many improvements have been made in this blower, as a result of which particularly high efficiency is obtained. A patented form of vaneless diffuser is used, which consists of a discharge ring. The advantage of this type of diffuser is that the air flows with a minimum of skin friction and eddying, and the effective range of operation of the blower is increased. The impeller is of the axial inlet radial-flow type, and together with the diffuser is carefully designed to obtain minimum power consumption. A feature of this type of impeller is that it produces sensibly constant pressure over a wide variation in volume.

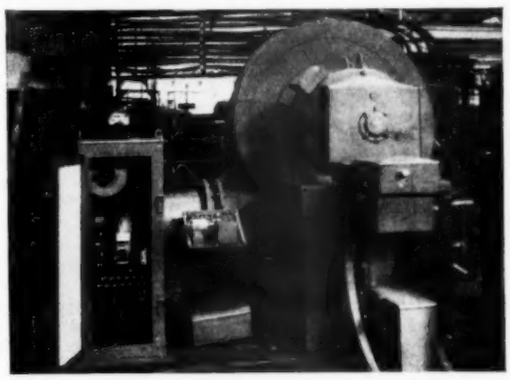

Fig. 2.—A View of a B.T.H. Cupola Blower on Test, showing Control Gear for Regulating Weight of Air to Cupola.

Welded sheet steel is used in the construction of the scroll casing, the weight of which is thereby considerably reduced. There are no parts of the blower, motor-operated blast-gate valve or control gear, liable to wear, the weight of air delivered thus being maintained within close limits at all times. This factor in cupola operation, which has been so hard to determine and regulate in the past, is now automatically controlled, and attention can be confined to maintaining the coke and iron in proper relation.

Coal-Oil or Oil-Coal Mixtures?—In the course of a discussion at the Institute of Fuel recently Dr. R. Lessing suggested that it might be wiser to refer to oil-coal rather than coal-oil mixtures, because if the latter term were used, and if the hyphen were omitted, misconceptions might arise, for it might be thought that one was dealing with coal oil, which was a very different matter.

Some Observations on the Character of Cast Iron.*

By A. C. Vivian, A.C.G.I., Assoc.M.Inst.C.E.

Introduction.

In offering the following Paper, it is desired to point out that the subject matter has been evolved from a study of elasticity and plasticity and other characteristics of materials in general. In the course of these researches it has been established that cast iron provides an admirable example of an elastic material which does not obey Hooke's Law but which is entirely rational in its behaviour.

One of the outstanding characteristics of cast iron is undoubtedly that the ultimate breaking strength calculated according to conventional methods from transverse tests is far greater than the ultimate breaking strength obtained by direct tensile test. This added strength, far from proving an asset to cast iron, has surrounded it with an uncertainty to its very real disadvantage. It is true that tensile and so-called "transverse" strength have been correlated empirically,[1] but the uncertainty has not been dispelled. The uncertainty is increased because the transverse strength of apparently identical bars varies widely and the tensile strength varies somewhat (though to a smaller extent than the transverse strength).

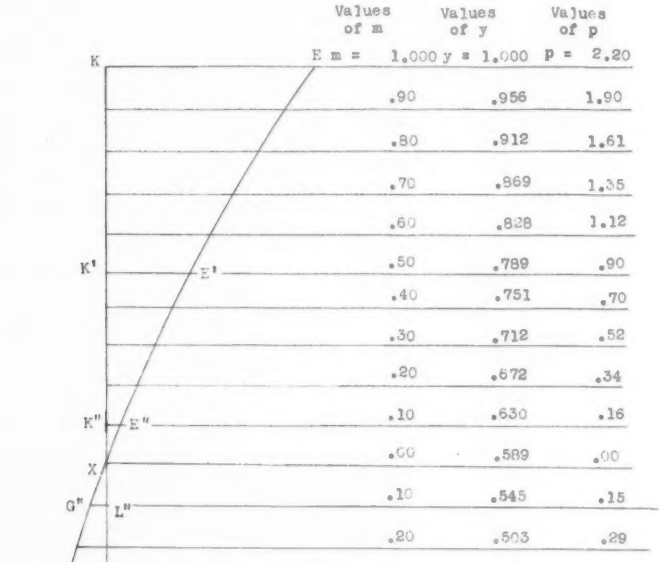

Fig. 1.—Transverse Stress Distribution.

(From "Civil Engineering and P.W. Review.")

The opinion which is advanced in this Paper as a result of an examination of test results on cast iron extending over many years is that this uncertainty is due to the attempt to interpret the physical properties of cast iron in terms of a mathematical theory which does not apply to it. It is as if an attempt were made to translate Italian solely with the aid of a Latin dictionary. The resulting translation would be inexact and uncertain.

An examination of some published test results on cast iron free from the limitations of conventional elastic theory may be the means of provoking constructive criticism leading to the removal from cast iron of any hypothetical inferiority complex which is sometimes attached to it.

Tensile Tests.

The author suggested some time ago[2] that shear effect plays an important part in the apparent value of ultimate breaking strength of cast iron. When a short thick bar of cast iron is pulled, the load is applied to the skin fibres. The centre longitudinal fibres can only be stretched by reason of the load being transmitted to the centre by shear force in the material. Unless the grip ends are long enough relative to diameter or thickness, the skin fibres will be stretched appreciably more than the centre fibres. Thus, short thick tensile specimens will show a much lower apparent tensile strength than specimens in which the grip ends are, relatively speaking, long and thin.

Mr. J. G. Pearce in a recent publication[3] has shown certain relative dimensions of tensile test-pieces under which this shear effect does not apparently exist. In the tests referred to, 1.2-in. dia. standard B.S.I. bars were pulled, the grip length being varied from 1 to 3 in. It is possible that if some of these bars had been reduced in diameter along the gauge length of, say, 0.564 in. dia. instead of to the standard 0.798 in. dia. for the 1.2-in. bar, a higher breaking strength would have been recorded. It is probable that if the standard 2.2 bar (with dimension D=1 in.) of the same material had been tested, a considerably lower breaking strength would have been registered. It is usual to ascribe the lower strength to poor metal at the centre due to mass effect. The author is of the opinion that most (though not all) of the apparent decrease in strength is due to shear effect.

Based on a general consideration of tensile-test results, cast iron which exhibits a maximum breaking strength of 14 tons per sq. in., for example, may sometimes fail on test at 12 tons per sq. in., but with test-pieces designed to eliminate shear effect it will rarely show a breaking strength of less than 13 tons per sq. in. Structural steel is often classified as 28 to 33 tons per sq. in. in ultimate strength, and it is reasonable to classify a particular grade of cast iron as 12/14-ton or 13/14-ton iron without reflecting in any way on its character for trustworthiness at ordinary working stresses. There is, however, a fundamental difference between the conventional breaking strength of steel and that of cast iron which requires careful consideration in design work. When structural steel is pulled there occurs at about 20 or 22 tons per sq. in. an appreciable elongation or yielding without increase of stress. The material, however, does not break and the load must be increased considerably to produce fracture. In the case of cast iron there is a small plastic yield, but the yield point is for all practical purposes synonymous with the break point. It is easy to see why mild steel, quite apart from its greater tensile strength has in the past replaced cast iron for bridges and other structural purposes. The appreciable elongation at the yield point does not destroy the elastic character of mild steel but provides a safety factor for the relief of secondary or localised stresses. Cast iron provides no such safety factor. If, by reason of faulty design or for reasons outside the control of designer or foundryman, points of localised high stress occur, cast iron lacks the ductility which would relieve such points of high stress.

A fundamental characteristic of cast iron (without alloy additions) is lack of ductility. The metal does, however, possess some plasticity or very slight ductility which should be given careful consideration and of which greater use might be made. The tensile-stress-strain line of

* A Paper presented to the London Branch of the Institute of British Foundrymen, on October 13, 1932, Mr. H. G. Sommerfield presiding.

1 "The Correlation of Mechanical Tests for Cast Iron," by J. G. Pearce, M.Sc., Exchange Paper of the Institute of British Foundrymen. Presented to the American Foundrymen's Association at the Cleveland Convention, 1930. Foundry Trade Journal, vol. 42, pp. 413-435, *et seq.*

2 "The Influence of Shape in Tensile Test-Bars." Foundry Trade Journal, January 28, 1932.

3 B.C.I.R.A. Bulletin, vol. 3, No. 10.

cast iron is curved and is made up of two components, one the elastic and the other the plastic or ductile component. It is important to realise that a material may be elastic and yet have a stress-elastic-strain line which is curved. In the case of cast iron the plastic component probably does not exceed 10 per cent. of the elastic component except near the break point, where it may be more, but where, unfortunately, it cannot be measured with any degree of certainty.

The tensile-stress-strain line of cast iron curves over and tends to become parallel with the strain axis near the break point. In this respect it is similar to concrete, the uses of which have been considerably increased by reinforcing it with steel. The practicability of reinforcing cast iron by incorporating steel rods where points of high-tensile stress are liable to occur warrants further investigation.

It will be appreciated that ductility or plasticity is not essential for many purposes provided that accurate methods for deducing stress distribution under specified loadings are available. For some purposes it is recognised that a ductile characteristic may be a disadvantage.

Transverse Tests.

As is known, when a bar which is of small cross-section relative to its length is loaded transversely, a longitudinal tensile stress is set up along one part and a compressive stress along the other, and these are the only appreciable stresses induced by the loading. A cast-iron beam fails when the extreme fibre-tensile stress reaches the ultimate breaking strength of the metal. If the extreme fibre-tensile stress is computed in accordance with the mathematical theory of elasticity, it may be found to be 60 to 100 per cent. higher than the tensile strength of the iron measured in the ordinary way. It is evident that the mathematical theory of elasticity is untrue of cast iron. The reason for the discrepancy would appear to be due to the curvature of the tensile-stress-strain line. It is simply convention to assume that the transverse-stress distribution is a straight line in accordance with Hooke's Law. This convention is, nevertheless, so widely accepted that cast iron has been to a large extent discredited because it does not conform to the mathematical theory of elasticity which depends for its validity upon Hooke's Law.

This is unjust to the mathematical theory which makes no claim to be applicable to cast iron. No aspersions will be cast if the mathematical theory of elasticity is discarded as useless for interpreting the character of cast iron. By doing so the uncertainty hitherto surrounding the transverse strength of cast iron does not arise. Under the theory proposed, the transverse-stress distribution of an ordinary grade of cast iron can be approximately represented by the diagram in Fig. 1. This is a type diagram. The curved line XG to the base line XL is the stress-strain line of the material in tension. The line GL represents the ultimate breaking strength of the iron. The curved line XE to the base line XK is the stress-strain line of the iron in compression. These lines represent the elastic characteristics and if stress-strain lines obtained by direct measurement (and in which the plastic has been separated from the elastic component) be examined, it will be found that the relative curvatures conform to those indicated by XG and XE. These lines will be easier to recognise if they are redrawn to the more usual scales adopted for stress-strain lines, and this can conveniently be accomplished by drawing base lines XL and XK respectively to the scale given but plotting the ordinates G'L', etc., to five or ten times the scale.

In the case of the tensile-stress-strain curve the plasticity which cast iron possesses will increase the curvature to some small extent. On the compression side, however, plasticity will decrease the curvature of the elastic line. It appears from test results that the compression plasticity is sufficient to reverse the curvature of the compression elastic line.

As to elasticity and plasticity the author would submit that when a piece of material is stressed the resistance to fracture is purely an elastic reaction. The stress induced in the material causes (1) an elastic strain which is dependent solely on the magnitude of the stress, and (2) a plastic strain which depends not only on the magnitude of the stress but also on the length of time during which the load causing the stress is applied.

Cast iron, in common with other materials, possesses both elasticity and plasticity in conjunction; but when, for example, a beam is loaded and then unloaded, only the elastic component of strain disappears. The plastic componet will remain in the test-piece. In order to correlate breaking strength obtained from direct tensile test with that obtained from the transverse test, it is necessary to distinguish between the plastic and the elastic components of strain.

If GXE in Fig. 1 represents the transverse-stress distribution, the reason for wide variations in transverse test results becomes apparent, for when the beam is subjected to a bending moment equal to 50 per cent. (*i.e.*, $m = 0.50$ in the figure) of calculated maximum moment of resistance of the section, the transverse-stress

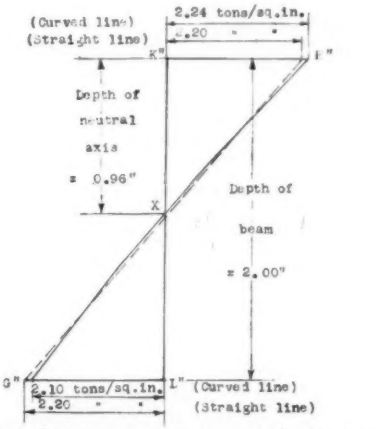

Fig. 2.—Transverse Stress Distribution when Bending Moment is 10 per cent. of the Maximum.

distribution will be G' X E', the extreme fibre tensile stress will be the ultimate breaking strength multiplied by $p = 0.67$, and the extreme fibre compressive stress will be the ultimate breaking strength multiplied by 0.90. (The diagram is so constructed that the tensile load represented by, for example, G' X L' is equal to the compressure load represented by K' X E'.)

When $m = 0.85$, the extreme fibre tensile stress has almost reached the ultimate value. Thus, a tiny flaw which would have no effect at lower stresses may precipitate failure at 85 per cent. of the maximum moment of resistance of the bar. At $m = 0.50$, however, it will be clear that tiny flaws or inequalities in material will have no such disastrous effect. The theoretical extreme fibre stress on the tension face when the bending moment is 85 per cent. of maximum is 96 per cent. of the ultimate breaking strength. Thus, a small variation in ultimate tensile strength of individual bars will produce large differences in maximum moment of resistance.

Fig. 2 shows the theoretical transverse-stress distribution when the bending moment is 10 per cent. of the maximum. The curved line should be compared with the similar line in Fig. 1, in which it is identical but drawn to a smaller scale. In Fig. 2 the dotted straight line shows that calculations based on Hooke's Law would at these low stresses give results almost identical with the curved line.

Specimens Tested As-Cast.

Messrs. C. H. Adamson and G. S. Bell have provided several very comprehensive series of transverse tests on bars as-cast in Iron and Steel Institute,[4] and since some of the results obtained from presumably similar bars differ widely from one another it is desired to make some deductions from them.

Among the results may be noted:—

(1) Bars 2 in. deep give less variable results than bars 1 in. deep.

(2) Round bars of 1 in. dia. occasionally exhibit a transverse strength far higher than would be deduced from results obtained on rectangular bars.

(3) About 15 per cent. of the bars tested were recorded as flawed.

If the stress distribution across a cast-iron beam is as shown in Fig. 1, a variation in breaking strength of 14 per cent. is equivalent to a variation in maximum moment of resistance of 30 per cent. One of the deductions which can be made from an examination of these test results is that the character of the skin of cast iron is less constant than the inside. If a machined tensile test-piece shows a variation of 10 per cent., the tensile strength of as-cast specimens may vary by 15 per cent. (The percentages stated are hypothetical for illustration purposes.) Furthermore, the skin has probably less plasticity than the metal inside in some cases and more in other cases, depending on slight differences in pouring conditions presumably difficult to control. These defects in the skin of the test-pieces will exert a very serious influence at high stresses if the transverse stress distribution is of the type shown in Fig. 1, although at lower stresses they will not be serious.

(1) If all other conditions are equal the moment of resistance of beams will vary as the square of their depths, so that if the skin is defective on the tension side to the same depth in each case, a 1-in. by 2-in. deep beam will show far less variations than 1-in. by 1-in. deep beam.

If the skin has less plasticity than the inside there will be a tendency for the tensile and compression loads set up by the transverse loading to be concentrated in the skin and for fracture to occur uncertainly owing to fortuitous defects in the skin.

(2) If the skin on the compression face suffers appreciable plastic yield before the stress on the tension face has reached the ultimate value, the transverse-stress distribution will depart from that shown in Fig. 1. The compression-stress-strain line XE will be reversed in curvature and the neutral axis X will tend to move towards the compression face. It is possible that the extreme fibre-tensile stress will not reach the ultimate breaking strength of the iron while this considerable plastic yield is being initiated on the compression side. The result would be to raise the apparent moment of resistance of the beam above that calculated from data assuming the transverse-stress distribution to be of the type shown in Fig. 1.

In brief, it is evident that plasticity on the compression face may increase the transverse strength appreciably. It is observable that this phenomenon is particularly in evidence on round bars of small diameter.

(3) The number of flaws recorded in the tests raises a question whether the results are representative of foundry practice to-day. Further research with a view to the reduction of, or the elimination of, flaws is desirable.

Dimensions of Test-Bars.

A thorough investigation of suitable sizes of test-bars is wanted.

[4] Carnegie Scholarship Memoirs, vol. xvi, 1927.

(*a*) *Tensile.*—The ratio of gripped length to gripped diameter should be, according to Mr. Pearce's results, not less than 1:1.2, but in addition the gauge part diameter for a 1.2-in. dia. bar should be reduced to about ½ in., or as otherwise determined by tests on various diameters with constant gripped diameter. With a large reduction it may be that a parallel part at the gauge diameter is not necessary.

(*b*) *Transverse.*—Machined test-bars 2 in. deep by 1 in. broad by 42 in. long will give more consistent results than small-diameter round bars. The round bar results can be correlated with the 2-in. deep rectangular bar in a satisfactory manner, and the latter should be used for laboratory testing, the round bar being used for routine testing pending further research concerning more suitable shapes.

General Remarks.

The conclusion which the author puts forward is that cast iron has a character which is essentially different from steel, and that it is a material of which considerably more use might be made if its character were closely investigated upon the lines suggested.

An important step must be to correlate transverse and tensile strength, and this can be done by making transverse and tensile tests both on machined and on "as-cast" specimens, care being taken to measure elastic and plastic components separately.

Engineering Considerations.

Specifications for structural steel are sufficiently comprehensive to assure engineers obtaining a constant grade of material by buying to specification.

In the case of cast iron, the question arises whether melting and casting conditions as well as chemical composition can be sufficiently closely specified to ensure that the same grade of metal can be produced in different foundries from time to time. The checks which the engineer prefers to apply are mechanical tests, chief among which are tensile and transverse tests. At present there exists an impression that a great many different varieties of cast iron are produced and that uniformity is to some extent lacking.

It has been the endeavour in this Paper to show that uncertainties about cast iron are to be attributed almost entirely to faulty theory and hardly at all to the material. It may well be that, if the transverse and tensile character of cast iron can be satisfactorily explained, a more comprehensive specification for cast iron than exists at present would be possible.

Metallurgical Considerations.

Mr. C. Howell Kain wrote:—

The Paper is very interesting, and offers an entirely new line of thought on the properties of cast iron, but there are a number of metallurgical considerations which must be borne in mind when studying these properties. Recent research and the development of high-strength irons have thrown considerable light on the variation of strength in identically similar test-bars. It is now known that comparatively small variations in melting and cooling conditions affect the result almost as much as changes in the nature of the raw material. Remarkable uniformity is now being obtained by careful standardisation of the charge, the melting conditions and the rate of cooling, particularly in irons melted from a high proportion of steel which would normally solidify with a white fracture, but which are treated in the ladle to obtain an all-grey structure.

The fall in strength when pulling a small test-bar from the centre of a larger one is due to the difference in structure caused by the different rates of cooling through a mass of metal. Small bars machined "off-centre" invariably yield greater strength than bars from the centre. But this difference in strength between the various portions of a casting is now being overcome in the case of high-strength irons. For instance, the writer recently cast some bars together, one series being ⅞ in. dia. and one 2½ in. dia. Bars of 0.564 in. dia. cut from the ⅞-in. bars yielded 22 tons per sq. in. tensile, and those from the 2¼-in. bars 21 tons per sq. in. This shows the advance which has been made.

The suggestion of a new nomenclature in specifications is a very good and useful one, and would help both technically and commercially, as it would tend to differentiate more definitely between cast irons meant for different purposes.

Reinforced Castings.

The idea of reinforcing castings with steel rods presents a number of practical difficulties. These may be tabulated as follow:—

(1) Steel rods would cause local modifications of structure which would alter the whole characteristics of the iron. Depending on their size, they would either (*a*) act as a "chill," which would cause a white-iron structure which would be hard and brittle, or (*b*) act as a "densener," causing a difference in structure, and in the case of superheated irons would (*c*) cause a ferrite-fine-graphite structure which would be weaker than the average strength of the casting.

(2) The metal might "blow" or "kick" from the rods, causing unsoundness.

(3) The finishing and closing of moulds would be greatly complicated.

The "give" or spring of some cast irons is a very useful property, and is one of the inherent properties of irons of the cold-blast type, which are so valuable.

The Factor of Rigidity.

Ductility is not always desirable, as in many cases an unyielding stiffness is more valuable. The modified nomenclature idea would allow of specifications being drawn up to cover both requirements.

He was pleased to see that Mr. Vivian has commented upon the number of flawed bars recorded in published tests. It is regrettable that so many of the bars used by research workers were flawed, particularly as there is no excuse for them, since almost any practical foundryman would be only too glad to give help and advice on the best method of casting any specimens required. Perhaps Mr. Gardom will indicate some of the work being done by the Technical Committee to standardise the methods of casting test-bars in order to overcome the troubles caused by flaws and make results more readily comparable.

Transverse test-bars machined to a size of 2 in. by 1 in. by 42 in. would be very expensive, and also would tend to flatter the quality of the iron.

Finally, this Paper should be a great help in the search for true knowledge of the properties of cast iron. The major requirement is not great strength, but much greater uniformity and soundness. When founders can guarantee uniformity and soundness, many of the doubts about cast iron would vanish and the markets available would be greatly increased.

Mr. J. G. Pearce (Director, British Cast Iron Research Association) wrote:—

The question brought forward by the author is of great importance to the foundry industry, because, if transverse and tensile tests on the same metal can be fundamentally instead of empirically correlated, the necessity for one of these tests will disappear, and the other will be used exclusively. As is well known, in this country the transverse is the preferred test, whilst in the States, although again both are specified, the tensile is preferred and transverse is optional.

I have many times insisted that, although cast iron does not show appreciable elongation on an ordinary tensile test, it does possess a measure of plasticity which gives it some capacity for adjustment to stress. It was because cast iron is not a suitable material for the application of Hooke's law and because foundrymen have so much to gain by the development of a proper basis for treatment, that the Cast Iron Research Association undertook some tests to enable Mr. Vivian to see whether his theory was justified by facts. The Association does, of course, not necessarily agree with Mr. Vivian's interpretation of the results, and I shall examine this with interest. For some years past an investigation has been in progress on the determination of elastic and plastic properties of cast iron, both in transverse and in direct tension and compression. This work was mentioned in my American Exchange Paper, referred to by Mr. Vivian, but the material is not yet sufficiently complete for publication. A variety of irons have shown a straight-line stress:strain curve for the elastic component in bending.

It is very important, in attempting to correlate transverse and tensile tests, that erratic variations should be eliminated and the testing procedure requires to be carefully standardised. In particular I recommend the skin machining of transverse bars before testing, and on this score alone it would be undesirable to go back to the 2-in. by 1-in. bar. The necessity for arriving at ideal dimensions, referred to by the author, also comes under this head. He has mentioned in his Paper that tests carried out in the laboratories of the Research Association do not show the shear effect that he fears on the standard 1.2-in. bar (which governs the bulk of production) if the grip length is 1 in. or over. Neither is there any such effect in the gauge length. The tests referred to have been carried a little further. A standard 1.2-in. bar has been tested with 2-in. and 1-in. gauge lengths with a grip length of only 0.54 in., at which, in Mr. Vivian's opinion, the shear effect, if it exists, would be demonstrated in the form of a low-tensile figure. For the same metal as reported in the B.C.I.R.A. Bulletin for April, 1932, page 86, the two bars gave tensiles of 16.80 and 17.14 tons per sq. in. It will be seen that the average of these two, 16.97, is almost exactly that obtained from bars of all grip lengths from 1 in. to 3 in. The problem of a short grip length seldom arises in 2.2-in. bars, because, although a 1-in. minimum grip length is permitted by B.E.S.A. 321, the broken transverse bar from which the tensile is machined is usually 10 in. long and the grip length is 2 in. to 3 in. I cannot agree with the author that most of the apparent decrease in strength of a thick bar compared with a thin bar of the same metal is due to the shear effect.

I have previously suggested that graphite coarsening towards the centre of a thick bar does not explain the whole of the drop in strength, but am not convinced that the shear effect contributes materially to the reduction

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"Chapmanising."—This is the name applied to what is claimed to be an entirely new process for case-hardening. The degree of hardness and the depth of the case can be regulated to suit the requirements of each job. The time required for the operation is reduced considerably, as compared with other case-hardening methods, and the cost is moderate. The process has been developed by the Chapman Valve Manufacturing Company, Indian Orchard, Mass.

Iron Ores Reduced by Hydrogen.—According to a Paper presented at the recent convention of the American Electro-Chemical Society, H. Kamura, of Japan, has experimented on a wide variety of Japanese iron ores. The ease of reducibility by hydrogen varied for different ores. Hematites reacted readily at 900 deg. C. and were completely converted to metal in 3 to 4 hrs. Magnetite sands required a temperature of 1,100 to 1,150 deg. C. Both sulphur and phosphorus are largely eliminated during reduction, forming H_2S and PH_3.—"Iron Age."

The Size of the Iron Foundry Industry.

A CHAOTIC STATISTICAL POSITION.

Mr. J. G. Pearce, M.Sc., M.I.E.E., director of the British Cast Iron Research Association, delivered his presidential address to the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen at the opening meeting of the session held at the Chamber of Commerce, Birmingham, on Friday, October 7. Mr. G. T. Lunt, the Vice-President, occupied the chair.

The PRESIDENT, after a brief description of the International Foundry Congress and Exhibition, which he had attended in Paris, and a reference to some developments in Germany, said: Many presidential addresses had dealt with the past and present of the industry, and it might therefore be appropriate if he directed attention to a consideration of its future.

Few people realised how extraordinarily difficult it was to obtain any concrete idea of the extent of the founding industry, which included grey-, white- and malleable-iron foundries, steel foundries and non-ferrous foundries. Two points will serve to illustrate this. The latest edition of the best trade directory available gave a total of about 2,500 ironfounders in Great Britain and Northern Ireland. In 1924 about 2,800 iron-foundries were recorded in Great Britain. From other sources he had been supplied with lists of foundries totalling well over four figures and making no claim to be comprehensive. The Board of Trade in the last Census of Production, taken in 1930 and reported early in this year, for the first time separated iron and steel founding from other industries. The total number of foundry establishments given in the report is 767. Apart from the fact that the Census did not record foundries employing ten men or less, he had not succeeded in explaining satisfactorily the enormous discrepancy between figures of about 2,500 and 767. Some discrepancy would be expected at a time like the present, when many foundries are closed, but this would not have been so great in 1930, the Census year, and should not, in any case, be of this magnitude. It was, therefore, probable that the Census figure was an under-estimate and the other an over-estimate. It was remarkable that so little information should exist about the number of foundries in the country, about the total output of the industry, the capital employed and the number of men employed, yet figures of this character are of enormous importance to founders. Only by comparing the fluctuations of business in the industry as a whole, or in a clearly-defined section of it, could a founder see whether his own business is doing better or worse than the average, and only by these means is it possible to separate out the causes of fluctuations in his own business which are under the control of the management and those world-wide, economic and political causes over which the founder has no control. In settling purchasing contracts, developments relating to building, equipment and staff, it must be of great importance to know whether business was receding or advancing with the ebb and flow of the business cycle, and such data would appear to be equally important to equipment and supply houses and to pig-iron and refined-iron manufacturers.

It was virtually impossible to determine the value of the capital employed in the industry for the production of castings is insuperably bound up with other productive processes. Figures for labour employed are easily ascertainable; for the Census of Production list the total employed is 85,000. Some years ago he endeavoured to work out a scheme for estimating the business fluctuations in the industry by estimating the tonnage of castings produced. He took the foundry pig-iron output, corrected for import and export figures, and added a proportion of the hematite-pig output used in the foundry trade. Allowance was made for a proportion of foundry pig used outside the foundry trade. If this total is increased by a figure representing the amount of scrap used with the pig and allowance made for runners, risers and wasters, a figure representing the total weight of finished castings produced is obtained. Such an estimate rests, of course, on a variety of assumptions, particularly that pig and scrap stocks remain constant over the period. The figures obtained are probably on the high side, but for the Census year the estimate yielded a figure of 1.75 million tons and for the current year (based on eight months) 1.2 million tons. Normal full production might be regarded as 2 million tons and by assigning an average value of £20 per ton to this output the value of normal production becomes 40 millions sterling. The output of the establishments covered by the Census in 1930 is given as 1.1 million tons and the value, which is an accurate figure, is £23.2 per ton, the total value being thus just over 25 millions sterling. My estimate for the same year was 35 millions, and it will be seen that the discrepancy between the Census output value and my estimate is much less than the discrepancy between the numbers of foundries in the two cases. It is extraordinary that the foundry industry should have such slender statistical information available, and we can only hope that the necessary data will be available in future. It is difficult to see how it could be obtained other than through the co-operation of fully representative trade associations in the industry.

The Future of the Industry.

The foundry was the cradle of the engineering industry and by virtue of our early start in the industrial race, due to the development of the steam engine, Great Britain taught the world to make industrial castings. In this respect the British were unusually well-favoured by Nature, for they had ample deposits of iron ore, coal which yields the finest metallurgical coke in the world and ample and widespread deposits of naturally-recurring refractories and moulding sands. The early British founders could afford to wait for customers to come to their doors. That situation was, of course, no longer true. Not only is the foundry art spread to relatively undeveloped countries, in itself a tribute to the basic necessity for castings in our present civilisation, but a number of industrial countries could produce castings as good as any made in this country. He had previously suggested that the outstanding characteristic of this country in the founding art at present was its admirable craftsmanship, just as that of America was mechanised and continuous production and of Germany was technical and scientific control. In both the last-mentiond directions British foundries had far to go if they were to meet modern conditions. At present industrial capacity was in excess of demand, and since the capital required for a small jobbing shop is small in relation to turnover, the industry is particularly liable to competition from outsiders entering the industry. The competition of alternative and substitute materials has always faced the foundry trade, and in addition to drop stampings and forgings, at the present time there was competition from synthetic moulded products or plastic materials and from welded structures. In particular those interested in welding were endeavouring very energetically to further their process by every legitimate means, for which one could have nothing but admiration. Although war and post-war conditions made it difficult to arrive at a definite conclusion, it was probable that the annual loss of tonnage to wrought materials was about equivalent to the normal increase in demand due to expansion, so that output was more or less stationary. The industry thus needed a fighting policy to win back some of the fields it has lost if it was to enjoy that expansion which was wanted by all those engaged in a progressive industry. Fortunately science was showing the way to numerous improvements in properties in the material, and furthermore the development of specialised products, where quality and service life were more important factors than price, was beginning to relieve the industry of the ignorant competition of the small back-street founder. Modern mechanical tests such as creep were showing castings in an unexpectedly favourable light compared with wrought materials, and the more one learnt the more one was convinced that founders had much to gain and nothing to lose by the fullest knowledge of the properties of their material. As evidence of the trend of engineering opinion, he quoted some significant remarks made by Mr. A. A. Jude in his recent presidential address to the Birmingham Metallurgical Society. He said that all metallurgists were striving to produce the ideal metal, which must cast easily and surely, forge easily and surely, rub on another piece of it without giving trouble, have a negligible coefficient of expansion with heat, must be easily machinable, must permit a working tensile stress of at least 20 tons per square inch, must be reliably tough so that it might be shaped any way and stress in any complex way without playing tricks, must keep its properties at any temperature met with in applied thermodynamics, must not corrode with any of the ordinary everyday chemicals (including air) and must withstand erosion under engineering demands. He suggested that this ideal metal was most likely to be realised in the form of an improved casting, which was the most satisfactory and stable form of metal.

Other countries, in developing the foundry art, did not enjoy the same natural resources as Great Britain, and endeavoured to offset these disabilities by scientific research, the only means at their disposal for making the best use of the resources they had. The advantage of this policy were now very apparent. For some years past British founders had been invited to pay tribute to foreign countries on a number of developments of a metallurgical or practical character. These were not, of course, all of equal value, but their existence was evidence of thought and activity in the foundry field abroad.

British adherence to purely practical methods of approach revealed deficiencies during the war of such a character that the Government elaborated a scheme for assisting industries to form self-governing research associations, of which the British Cast Iron Research Association was one of about a score. It was only right to say that British industrial weakness did not arise from the lack of scientific research workers. It was due to their apparent inability to apply the results to practice. Here, again, the great difficulty was the small size of the average British plant. This in itself was not necessarily bad. The present time was proving that an industry of small units can withstand a depressed period much better than a country in which large units were more common, as, for example, the United States. It was necessary to accept the present industrial structure, which suited domestic conditions best, and to overcome the deficiencies referred to by co-operation, and this was the great advantage of the research association plan, which permitted firms to co-operate to carry out research which no one was large enough to undertake independently. The main difficulty arose from the tendency of British firms to work independently and to avoid co-operation, which militated against all forms of industrial association in this country, whether it be a trade associa-

tion or a research association. The basis importance of the industry was at present one of its handicaps, for most works in the engineering industry wish to be independent of outside sources of supply of castings. With so many establishments, it was unlikely that any move would be made in the industry parallel to those in the steel and shipbuilding industries, where efforts were being made to acquire and close redundant shops and yards. By concentrating production at a few centres the necessary economy in manufacture was secured from fully-employed plant. Thus, in Germany at present the whole of the manufacture of ingot moulds for steel ingot was concentrated in three works. Without the will to corporate action and its active expression, the present policy would persist in driving to the wall those least fitted to survive. The danger of this policy was that it was almost as weakening to victors as to vanquished, and there was nothing to stop the marginal founder from returning to the fray when conditions improved. The word "marginal" was used to imply a foundry that operated in good times when prices had risen and demand was active, and closed in bad times when prices were low and demand slack.

The Importance of Education.

Scientific developments could be best applied to industry through a scientifically-trained personnel, and at the present time, while a valuable step forward had been taken in the provision of certificates for craftsmen and for those who aspire to higher positions, there was at present no means in Great Britain whereby men of suitable preliminary training may be equipped for the highest positions in the foundry industry. During the recent Paris Congress an opportunity was offered for inspecting the work of the Foundry High School, and it was interesting to note that, although originally both practical men and men of what might be termed university standing were admitted to the school after at least six months' foundry training, at the present time the large majority of the entries come from graduates of the great French scientific schools, which were equivalent to British universities. The course was therefore becoming virtually a post-graduate course. In Germany a school of the highest rank was available at Aachen, where university students who had taken a preliminary two years' course may spend a further two years specialising entirely in the Foundry Institute on the art and science of founding and both schools granted a State-recognised diploma. There was a great need of one such school in Great Britain, but not more than one. Most would have seen the proposals of Mr. V. C. Faulkner in a recent issue of The Foundry Trade Journal for establishing such a school in this city. Pending further consideration, however, he would not make any comment on it.

He suggested that the progress of the Junior Sections of the Institute might be materially accelerated if there were made classes for assisting candidates for the two certificates now in existence. The young men would thus obtain, from practical founders and metallurgists, that contact with real things which was apt to be lacking in any scheme of formal education in the schools. It was characteristic of every great profession that it wished to have a hand in determining the fitness of candidates who desired admission to it. These sections would supplement and not in any way replace the work of the technical schools.

During the past ten years remarkable changes had come over the industry. The enormous development of special irons, both straight and alloyed, with hitherto undreamed of properties, for particular classes of service, the growth of buying to specification, both castings and foundry raw materials, and the growth of testing incidental to this, the enormous increase in technical control required in mechanised and continuous production, all emphasised the need for scientific assistance not necessarily in the laboratory, but more particularly in the foundry itself. Even those works requiring to melt the cheapest types of iron were paying great attention to melting equipment and the melting process and to finishing processes, such as enamelling. By the aid of science, more economical production was enabling the industry to compete more effectively with alternative materials and processes, and by producing better quality the industry was slowly relieving itself of ignorant and unthinking competition.

Research Associations and Industry.

Many of the research associations had a very close connection with a trade or manufacturers' association in their particular industries. Indeed, many such associations were entirely financed by these bodies, who derived their funds from a levy on members. The variety of these organisations in the foundry industry made it difficult to finance the British Cast Iron Research Association on this basis, but a strong connection with the trade associations is both natural and proper. In opening their extended laboratories in July last, Lord Rutherford, with the full weight of his authority as chairman of the Council of Scientists which advised the Government on matters relating to grant aid, pointed out that industries formerly exposed to the full blast of unrestricted competition now enjoyed the comparative shelter of a protective tariff. He pointed out that the public would expect an industry so assisted to be aware of the need for reorganisation and of scientific research, which experience had shown to be essential if industry is to compete on equal terms to-day.

Since 1924 the Cast Iron Research Association had met with a considerable measure of success. During this period its income had more than doubled, and it had issued or made available to its members over one hundred research reports and nearly two hundred other reports and translations. It did not conduct academic investigations of doubtful utility, but focussed attention on particular problems confronting the trade. It endeavoured to assist members in applying the results to practice, to achieve one or other of the above-mentioned aims of cheapening production or improving quality. Being national in character, and advised by many eminent scientists and metallurgists, its work had a standing and impartiality which carried much weight with users.

The Institute and the Association.

The connection between the Association and the Institute was, and always had been, very close. Each body was represented on the Council of the other, and they had co-operated fruitfully on matters relating to education, specifications and the like. For many years the President of the Institute had been a member of the Association. Their fields of work were complementary. The Institute was mainly concerned with the individual and the improvement of his technical and practical knowledge. The Association was essentially a body of works, mainly concerned with methods, processes and problems. Since the individual was employed in the works, the closeness of the connection was obvious.

Stimulated by the work of the Technical Committee of the A.F.A. and also, it may fairly be claimed, by the work of the Research Association itself, the Institute had recently set up a Technical Committee. The Research Association watched this development with interest and sympathy, recognising at once the value of a properly-constituted channel whereby the Institute could express its views on various technical matters, such as specifications. A small committee was appointed to arrange that there should be no overlapping or duplication in this development. The question arose as to how far the facilities offered by the Research Association may and should be used for the work of the Technical Committee. In the Research Association, the industry had a means for conducting investigations of the highest order of accuracy and in a manner calculated to convince buyers and users. The Association desired to assist the Institute in its work in the fullest possible way, and this could be enormously facilitated by a contribution from the Institute to the funds of the Association, which was both under-staffed and under-equipped even for its present programme. Such a contribution might readily be arranged to furnish the Institute members with full access to the Association's library and information service and to cover subscription to the Bulletin of abstracts. The Association had much experience in the peculiar difficulties of conducting and interpreting tests carried out under works conditions where, in the nature of things, all the variables could not be controlled.

No one recognised more fully than he that a heavy industry needed for its maintenance more than research. The founding industry needed not only industrial research itself, which could teach members more about the possibilities of our material and how to realise them, but industrial education through which one would make the best use of research and that industrial development which covered the application of research to production, the development of new equipment and also salesmanship and publicity.

Following the address a number of lantern slides were shown dealing with foundry developments, following which an interesting discussion took place.

The Chairman said that while, hitherto, their section of the trade which had been described with truth as the Cinderella of engineering, the Institute had done good work to establish founding as a science or higher art. They owed their thanks to Mr. Pearce and the Research Association for the help they had given the industry in improving its position.

Mr. G. W. Brown, in proposing a vote of thanks to Mr. Pearce, spoke of the high esteem in which he was held by the foundry world and the engineering trade generally, and said he knew of no branch of the engineering trade which showed more enthusiasm for its craft than the foundry department. In his view, the beginning of any progress that was made would be in the foundry. Referring to the forthcoming visit of the Branch to the Longbridge works of the Austin Motor Company, Limited, Mr. Brown extended a hearty invitation to the members to avail themselves of the facilities offered.

Mr. W. J. Molineux, in seconding the motion, said that Mr. Pearce by drawing upon his knowledge of developments in other countries had indicated the line they should take to further the interests of the industry. During a time of trade depression, such as the present, they had time to consider what other nations were doing and how to improve their methods, if possible. He was rather astonished to hear of the uncertainty existing as to the number of foundries in the country and how many people were employed. In the matter of competition, the observations of Mr. Pearce gave them food for thought. There was no doubt that, in some of the heavier industries, fabricated steel structures were taking the place of castings, and that plastic materials were also serious competitors. Mr. Molineux added that they looked forward to a very pleasant and progressive year under the presidency of Mr. Pearce.

The vote of thanks was heartily accorded, and Mr. Pearce spoke briefly in acknowledgment.

The President presented to Mr. T. R. Twigger the diploma awarded to him for his Paper "Some recent developments in Automobile Cast Irons," given before the Birmingham, Coventry and West Midlands Branch.

A number of diagrams were subsequently shown on the screen to illustrate the effect of total carbon and silicon on the strength of cast iron; also the effect of graphite size.

Price Cutting.

LESSONS FROM STATISTICS.

The Lancashire Branch of the I.B.F. held their opening meeting of the session 1932-33 in the Manchester Openshaw Junior Technical School on October 1. Mr. Ellis Flower, the Branch-President took the chair. Mr. S. P. Howden, the Principal of this School, has for some time taken a great interest in the educational work of the Lancashire Branch, and has worked very hard to induce the authorities to extend the arrangements made last year for classes preparing students for the certificate of the City and Guilds of London Institute in Foundry Practice and Science. To show the Branch's appreciation of his efforts this meeting was held in the School. The Branch-President remarked that the programme arranged for the meeting was rather an innovation, at any rate as far as the Lancashire Branch was concerned, in that tea was being provided in the School, after which a smoking concert was to be held, at which they would be entertained by the Manchester Male Voice Choir.

Several influential visitors were present, notably Mr. Shackleton Bailey, M.P., for the division in which the School is situated. He (Mr. Flower) thought it was a step in the right direction to invite representatives of the general public to attend the meetings on special occasions. It would help to remove misconceptions as to the nature and the relative importance of the foundry industry which, generally, the public were apt to overlook.

Mr. Flower proceeded to deliver his presidential address, in the course of which, after thanking the members for the honour conferred upon him by electing him as President of the largest Branch of the Institute of British Foundrymen, he said he hoped, that during his term of office, to be able to emulate the good work carried out by his predecessor, Mr. Roy Stubbs. He fully realised the magnitude of his task, especially when the progressive work accomplished during the past session was reviewed. One of the greatest troubles the Lancashire Branch had had to contend with during the past few years had been the steady accumulation of arrears of subscription. This had not been the fault of any individual, but was due entirely to the great stagnation of trade in the founding industry and to the strained economic position of a few members. Mr. Stubbs, with all the courage at his command, by persistent correspondence, and with the help of a most efficient secretary, Mr. J. E. Cooke, was instrumental in reducing these arrears from £252 to £87. If this had been the only achievement of the past session, the Branch would have more than justified its existence.

The Session Reviewed.

With reference to the lectures for the 1931-32 Session, they were so good, and so varied in treatment and subject, that it was almost impossible to say that any one was better or more popular than another. The April lecture, however, deserves special mention, for it was of such a progressive and constructive, if not revolutionary nature, that it could not help but appeal to any body of foundrymen. The meeting was a most enthusiastic one, and the Branch was honoured by the presence of such distinguished visitors as several Russian engineers, one of the greatest Professors of Metallurgy, Prof. Rhead; Major Bird, the managing director of Messrs. Armstrong-Whitworth, Limited, Gateshead-on-Tyne, and several members of the Newcastle Branch. The works visits were also well attended; the visit to the Grin Quarries of the Clay Cross Company at Buxton being the most popular.

The Junior Session.

It was pleasing to record that under the chairmanship of Mr. H. V. Grundy, the Junior Section made steady progress. This progress ought to be accelerated, and he appealed for added assistance for this section. No one was in need of more help than the boys who were entering, or have already entered, the foundry industry, owing to two outstanding facts, the first and most important of which is that they have taken up a careeer of a hard, dirty, laborious, but most highly-skilled nature. Secondly, the majority of boys who were leaving school, from their own observations of foundrymen leaving work, and from prejudice against the foundry, which was sometimes fostered by their parents, decided that they ought to have a job where they could leave work with a clean collar. The result was that this type of employment had become overcrowded, and young men found when they had finished their apprenticeship and made application for a responsible position, that the competition for that position was intense.

For these reasons the boys who entered the foundry must be coached with all the patience and thoroughness possible, and if members of the senior section would regard apprentices as near relations the industry would gradually attract the better class of boys and their parents would become interested in the foundry.

The Work of the Sections.

The Burnley Section appeared to prosper as the years advance, thanks to the great work of the pioneers of that Section, who were, of course, members of the parent Branch. Last, but not least, there was the founding of the Preston Section, which was composed of members who were brimming over with confidence and enthusiasm. He expressed the thanks of the Lancashire Branch to Mr. W. West, who had worked so hard in the formation of the Preston Section. The session of 1931-32 closed after one of the most progressive periods in the history of the Lancashire Branch, a session during which any individual might have been proud to have been the President.

The Price War.

It is usual in a presidential address to review briefly the state of trade and the prospects of the immediate future. The optimistic prospects held out by many people for the foundry industry twelve months ago have not materialised; in fact, trade has, if possible, been even worse than ever after studying the industrial position of the country, as well as its political aspect, he could not see any material improvement in conditions in the near future, for the simple reason that foundrymen seemed to be tackling the problem from entirely the wrong point of view. All the industrial economists of our time appeared to see a solution to the trade difficulties in the lowering of the cost of saleable commodities. In our case these commodities were castings. If this could be done by greater efficiency in the methods of producing castings, so much the better for both the producer and the user of castings. No one was more alive to this than the modern foundryman, as was shown by the fact that more progress has been made in the foundry industry during the past twenty years than in any other section of engineering.

Material Progress Made.

Innovations such as improved moulding machines, sand-conditioning plant and conveyors, sand-slingers, continuous-casting processes, as well as the greater efficiency of the executives of the modern foundry, were remarkable, and were due to a great extent to the foresight and enterprise of foundrymen who have been actively associated with the Institute. But, he asked, had this accumulated concentration upon cheaper and quicker production of castings improved the economic position in the foundry industry? The actual statistics of the trade generally all point in the opposite direction. This acute position has not been caused by the adoption of improved methods of production, but by a state of general stagnation in world trade, principally due, as all the world's economists tell us, to false, uneconomic selling prices of basic commodities.

Yet, in spite of all this, foundrymen continued to believe that it was a wise policy to persist in cutting the price of castings until one saw foundry after foundry going into liquidation. If it were possible to keep on cutting until we were delivering castings as cheap as the price of the air, it would not improve the general state of trade one iota.

The Statistical Position.

Due respect and appreciation for all the valuable scientific help contributed to the industry by individual investigators and technical associations was gratefully accorded, but the fact remained, and ought to be obvious to every section of the engineering industry, that the foundryman was the foundation, and that all other branches were based, and were entirely dependent, upon the economic strength of that foundation. Remove the foundry and its personnel, and what was the result? Not only engineering, and all its subsidiary trades, but the very base of the complex organism known as modern civilisation was shaken; production, trading and transport all become impossible.

It follows, therefore, that the status of the foundry can be raised as an industry; it would at the same time raise the status of everyone connected directly or indirectly with it.

It is significant that only so recently as in 1930 was the foundry trade regarded officially as an industry. This recognition was not the result of the foresight or activities of foundrymen, but mainly to the editorial policy of The Foundry Trade Journal; little comparative data will be available, therefore, until about 1937 or 1938. In the last census the Government only took into consideration 767 foundries out of approximately 3,000, and, of course, these were some of the largest in the country. The foundries mentioned made over 1,000,000 tons of castings per annum, and employed 84,019 people, including executives. The approximate value of the castings produced was £27,524,000, and the value in cash of the product of each employee was £188 per annum. This appeared to be a very sorry figure for such an important and basic industry as ours. It did not leave much margin for the carrying out of improvements, after purchasing materials, paying adequate wages, and allocating profits, if any.

Politics and Trade.

Since Elizabethan times all the most important countries in the world have been in the keenest competition with each other, and have sought to hold for themselves the best and finest defensive forces, such as armies and navies. Yet, if anyone had possessed the courage 15 years ago to have expounded the theory that this fight between nations for so-called supremacy was a pure waste of time, energy and money, they would have been not only ridiculed, but promptly ostracised. But the Naval Pact, which was signed in April, 1930, proved that even peoples, between whom active hostilities had continued until each country was slowly bleeding to death, had at last realised the folly of this unceasing competition which was slowly strangling them.

The Trade War Losses.

The British foundry industry is at present in a somewhat similar position as regards compe-

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tition, the keenness of which was slowly strangling it. No fewer than 520 foundries had gone into liquidation in this country during the past ten years. Looking at the position locally, taking the whole of Lancashire as local, the number of foundries that had gone out of existence in this limited area exceeds 200. Some of these concerns could date back their existence for more than a century, and their demise was almost entirely due to the suicidal policy of ridiculous competition. The foregoing figures were presented with the greatest reservation, for he had found it impossible to obtain statistics from any official source, so far as the foundry industry was concerned, again proving the inadequacy of its organisation.

The President emphasised that he was still a believer in competition, because he realised that sound economic competition is a driving force to success, but at the same time it was obvious that uneconomic competition was courting disaster. The chaos in the industry had, no doubt, been accentuated by the terrible post-war conditions, but chaos had always existed in respect to a general costing system in foundries, and would continue until such times as the industry determined to stamp it out by formulating some general principles of costing which can be a guide to the stabilisation of prices.

Costing and Competition.

What was the current position? No one knew the value of castings better than the foundryman who had to make and sell them, but was that knowledge taken into account when quoting for an inquiry. There were hundreds of foundries in this country all of which seemed to have a private and particular system of their own, if some of them could be given such an appellation, for determining how the true cost of a job should be ascertained. Some of these systems were ideal, but supposing one particular foundry was asked to quote for a certain job, and the price was arrived at by whatever system was operated. Would the conclusions reached by that system be the determining factor which fixed its quotation, or would the fear that a competitor might not quote a reasonable price be the predominating factor, irrespective as to what profit, if any, it might ultimately make?

It might happen that a foundry had quoted for this same job on a previous occasion, and had lost the order owing to its price being too high. Would the attitude at the second attempt be that the job must be looked at from the point of view of the previous failure to secure the order and that the price must be lowered regardless as to whether its competitor had made a profit or not and whether it came up against some unexpected problem in the making of the job of which the first would be quite in ignorance? Past experiences would provide the answer.

The Unscrupulous Buyer.

Again, it was quite true that in some cases agents use every means available to obtain the lowest possible price, irrespective as to whether the foundry made a profit or went into liquidation, and who was to blame in this case if the foundry lost? Certainly not the buyers. There was no doubt that the trade was at times exploited by unscrupulous buyers who went from foundry to foundry playing off one against another and quoting other peoples' prices, true or fanciful. Undue advantage was certainly being taken of current conditions, but infinitely greater opportunities present themselves to these astute individuals as a result of the lack of organisation from a selling point of view. Indeed, this weakness appeared to be obvious to everybody except those engaged in the production of castings for sale.

It was really astounding that a basic industry should be run on such unbusinesslike lines, but there was no doubt that the time was long overdue when something should be done along these lines, not only from a social point of view, but from an economic one. At one time the foundry was asked for, and was expected to produce, rough castings, but with the advent of mass production and the consequent advance in machine-shop practice, the use of more elaborate machinery, the more extensive use of jigs, and the revolution in design during the past 20 years, the intricacy of castings tended to make production much more costly, and greater allowances had to be allocated in providing against troubles due to contraction, etc. Another great difference between production now and 20 years ago was that in the old days weight was treated as a secondary consideration, and if extra strength was required in a particular section an extra thickness of metal was allowed. The fallacy of this practice had now been proved beyond doubt. The orthodox design of a casting at the present time was to have an equal thickness of metal throughout the entire structure, as far as was practically possible. This often added to the difficulties of the founder from a production point of view, and at the same time took away from him considerable revenue in the total weight of the casting. Yet the selling of castings by weight alone continued to be the fundamental principle governing the price.

Better Quality at Lower Prices.

Again, there were the expensive, high-quality irons now available, the advantages of which the engineer seemed to be quite conversant with, and which the foundryman was quite capable and willing to produce. The engineer seemed to be obsessed with the idea that all these things can be obtained by simply incorporating them in a specification without expecting any added cost to the product. The people who encouraged the perpetuation of this idea were often the foundrymen themselves by the manner in which they belittle their industry and its products through the pernicious system of cut-throat competition. Engineers must be made to realise that in founding, as in tailoring, it is unreasonable to expect Bond Street materials and Saville Row cut for Caledonian Market prices.

The Incidence of Taxation.

When foundrymen allowed production costs and overhead charges to increase far and above the income obtainable from the sale of castings it did not take a skilled economist to realise that bankruptcy lay straight ahead. That was precisely the position in which this country stands at present, as was shown by the following facts. The national expenditure before the war was approximately £200,000,000, to-day it had reached the colossal figure of approximately £800,000,000. All this revenue has to be found by the imposition of taxation of different kinds, and it must all be raised out of industry. Thirty years ago 1s. in the £ was sufficient to cope with all our needs.

Those figures referred, of course, to national taxation only. Local taxation, in the form of rating, certainly hit industries more directly. This in 1913 was approximately £19,000,000, and in 1931 had increased to £165,000,000. Money borrowed by local authorities in the same period increased by over 100 per cent. A great portion of this abnormally-increased burden had to be borne by the foundry industry. How could foundrymen, even though they may hold the key industry in engineering, expect to solve, or even alleviate their present position by undercutting each other into bankruptcy?

Must they wait, asked the President, sitting on the brink of liquidation, until they are ultimately engulfed? Would not the better policy seem to lie in a determined effort to place the industry on a sounder and better financial basis. He was sorry to have been compelled to take up this rather pessimistic attitude, but he felt that it would have been misleading to have continued to reiterate the time-worn, decrepit, hardy annual that trade was improving, or was likely to improve in the very near future. He believed it was time that founders stood up and boldly faced the fact that the foundry industry was in urgent need of serious and drastic reorganisation, to rescue it from the deplorable conditions which existed.

A Lesson Still to be Learned.

It would be a great pleasure to him to be able to have concluded on an optimistic note. He thought the signs observable at the moment would suggest that the next ten years would witness changes in trading conditions which would enable the efficiently-organised sections in engineering to obtain satisfactory financial returns. Was the foundryman during that period to remain satisfied that his first duty was to undermine the security of all his competitors, by progressively reducing prices regardless of the effect upon his own condition?

With every other section flourishing, and himself working harder than ever, was he to remain content in regarding his occupation, and allowing others to regard it, as the Cinderella trade?

The moment was opportune to put our house in order, so that when this time arrived they would be able to reap that which they have never yet had, a just and adequate return for their labours.

Vote of Thanks.

In proposing a vote of thanks to the Branch-President for his address, Mr. J. S. G. Primrose said that they would all appreciate the courage which prompted the President to bring before them an aspect of the foundry trade in which there was real need of standardising, before any real progress could be made in combating the effect of the depression. Although the key-note of the address had been rather a pessimistic one, still reference had been made to matters affecting competition which were frequently in the minds of founders, and which had frequently caused grumbling and dissatisfaction in the past. Drastic action to meet unfair competition had been advocated, even if the line of that action had not been directly formulated. Stimulated to action by their President's words, he felt sure it depended upon each one who suffered to find the root of the canker and cut it out, so that restored health might result.

Mr. J. Hogg used some homely illustrations of the power of a presidential address in seconding the vote of thanks, which was passed unanimously with hearty acclamation.

Chromium-Plated Reamers.—Because of extremely close limits allowed for valve tappet holes in cylinder blocks, plus 0.0005 and minus 0.0001 on a 0.624-in. hole, an automobile manufacturer found high-speed steel finishing reamers would produce only 1,200 holes before being worn undersize. A tungsten carbide tipped reamer was tried and produced 72,000 holes within the limit, but the difficulty was that the reamer body wore down directly behind the tungsten carbide tips. A new reamer was made and the body chromium plated—after producing 160,000 holes, this reamer was still in service.—"Steel."

Iron Ore in Malaya.—The biggest Japanese iron-ore mine in Malaya is owned by the Nippon Mining Company, who operate at Kuala Dungun near the coast of Trengganu. But their output, about 200,000 to 300,000 tons per year, is not the largest among Japanese interests in Malaya. Isihara Sangyo Koshi, Limited, have been mining in Malaya for twelve years, and operate at Batu Pahat, from where they export something like 500,000 tons per year to Japan, and at Kuala Dungun, Trengganu, also, where the production figures are in the neighbourhood of 30,000 tons per year. Much is expected of the iron deposits, acquired recently by the Tochigi Shoji Kaisha, of Kobe, on the upper forks of the Muar River, emptying into the Johore Straits. These deposits, which are estimated to run into tens of millions of tons, are said to be remarkably rich in their percentage of iron, containing as much as 65 per cent. The company is also interested in a hitherto unknown iron-ore field in Kedah.—"Eastern Engineering and Commerce."

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This Week's News in Brief.

Trade Talk.

The calculated output of open-hearth and Bessemer-steel ingots in September totalled 975,061 tons, as against 832,402 in August.

Messrs. A. T. Green & Sons, Limited, Northfield Engineering Works, Rotherham, have booked orders from a German company for steel-furnace equipment.

It is understood that a Commission from the Soviet Union is making inquiries at Tyne and Clyde shipyards with the object of placing orders for vessels.

The nominal capital of Armstrong-Saurer Commercial Vehicles, Limited, has been increased by the addition of £100,000 in £1 ordinary shares beyond the registered capital of £100,000.

Mr. Robert Gillam, 1,436, Leeds Road, Thornbury, Bradford, lately carrying on business at Bowling Ironworks, Bradford, iron merchant, is paying a third and final dividend of 3¼d. in the £.

Messrs. Spermolin, Limited, makers of the well-known core binders, core machines and sand mixers, have appointed Mr. Alfred C. Turner, of 20, Budge Row, Cannon Street, E.C.4, their agent for London and the Southern Counties.

The International Metal Company, Limited, is paying a first and final dividend to non-enemy creditors of 17s. 11½d. in the £. The dividend is payable at the office of the Official Receiver and Liquidator, 33, Carey Street, Lincoln's Inn, London, W.C.2.

Messrs. Yarrow & Company, Limited, Scotstoun, Glasgow, have received an order from the Burmah Oil Company for a Yarrow water-tube-type boiler. This boiler will be manufactured at Scotstoun and shipped in sections for re-erection in Burmah.

A report from Washington states that Senator T. L. Oddie, of Nevada, has urged Mr. Ogden Mills, the Secretary to the Treasury, to invoke the Anti-Dumping Act of 1921 against imports of manganese ore from British India, the Gold Coast, Russia and Brazil.

The completion on October 15 of the excavation of a three-mile tunnel from the River Spean to Loch Treig marked another stage in the realisation of the Lockaber water power scheme of the British Aluminium Company, Limited. To date the company have spent £4,500,000 on the scheme.

Facts concerning the building of the Sydney Harbour Bridge were given to a large audience at the Institution of Mechanical Engineers, Neville Hall, Newcastle, on October 13, by Mr. Lawrence Ennis, of Messrs. Dorman, Long & Company, Limited, under whose supervision the bridge was built.

The index number of shipping freights for September at 19.06 shows an increase of 9.10 per cent. compared with August, and is 3.31 per cent. higher than a year ago, states the Chamber of Shipping of the United Kingdom. Freights measured in terms of gold were about 22 per cent. lower than a year ago.

It is officially announced that the directors of Messrs. Tweedales & Smalley (1920), Limited, textile machinery manufacturers, of Rochdale, have received an offer from Textile Machinery Makers, Limited, to purchase the business. An extraordinary general meeting of shareholders will be held to consider the proposal on October 28.

Particulars have been filed by the English Steel Corporation, Limited, of debenture stock for £1,150,000 (£800,000 "A" and £350,000 "B"), authorised September 22, 1932, and covered by a trust deed of the same date, the whole amount being now issued. The company is authorised to issue further "A" and "B" stock up to the limit of £1,500,000.

As a result of the audit of the employers' books for the quarter ended September 30, the secretaries of the Board of Conciliation for the Regulation of Wages in the Pig-Iron Trade of Scotland have received intimation that the average net selling price was £3 7s. 5d., which means that there will be no change in the wages of the workers on basis rates.

A Yokohama correspondent writes that the steel market is getting stronger daily. The latest prices, compared with the lowest rates in July, show a rise of 39 per cent. for tinplates, of 24 per cent. for plates, of 23 per cent. for medium plates, of 20 per cent. for round bars, of 17 per cent. for angles, of 10 per cent. for black sheets and of 8 per cent. for wire rods.

Shipbuilding is at present at a very low ebb on the Tyne. There is not one mercantile vessel on the stocks. The only building berth occupied carries a Portuguese sloop which is shortly to be launched at Hebburn. Official instructions to proceed with the building of the four destroyers, for which orders have been placed by the Admiralty, have not yet been received.

The 304th Cutlers' Feast was held in Sheffield on October 19. Sir Philip Cunliffe-Lister, Secretary of State for the Colonies, was the principal guest of the new Master Cutler, Lieut.-Col. A. N. Lee. Sir Arthur Balfour proposed "His Majesty's Ministers," to which Sir Philip Cunliffe-Lister replied. Other speakers included Mr. P. W. Lee, Sir Ernest Benn and Major Ian Hay Beith.

The engineers and mechanics employed at the Caledonian Works of Messrs. Barry, Ostlere & Shepherd, Limited, Kirkcaldy, downed tools on October 17, following the introduction of the firm's Bedaux system into the engineering shop. The matter has been taken in hand by the Amalgamated Engineering Union, but so far no negotiations have been entered into between the men affected and the firm.

The Standing Committee appointed by the Board of Trade will hold an inquiry at 11.30 a.m. on Monday, November 7, and, if necessary, at 10.30 a.m. on Tuesday, November 8, as to whether imported bifurcated and tubular rivets of metal should be required to bear an indication of origin. The inquiry will be held at the Board of Trade Offices, Great George Street, London, S.W.1. Communications should be addressed to the secretary, Mr. E. W. Reardon, at that address.

A new company has been formed to start a brickworks in the Banknock district of Stirlingshire. The company has purchased about 30 acres of land, which includes the extensive waste bings at the old Cannerton and Livingstone pits, which contain great quantities of blaes and fireclay. A start is being made immediately with the construction of kilns on the continuous principle, and the most up-to-date brick-making machinery is being installed. Test lots of bricks made from the materials have proved to be of a very high quality.

A long list of new and supplementary import duties was issued by the Irish Free State Department of Industry and Commerce on October 19. They took effect as from Thursday, October 20. The following are among the principal items on the list:—Springs for mattresses, etc. (duty 37½ per cent.), sheet lead and piping (15 per cent.), bronze and gunmetal articles (75 per cent.), manufactured articles of tin (15 per cent.), component parts of wheeled vehicles drawn by animals and unassembled iron and steel parts of motor-omnibuses, charabancs and lorries (75 per cent.). The usual preferential rates (two-thirds of the rates quoted) apply to British and Dominion goods.

Company Reports.

Babcock & Wilcox, Limited.—Interim dividend of 4½ per cent., less tax, on the ordinary shares.

Stothert & Pitt, Limited.—Loss for year, £16,628; brought in, £5,643; from reserve, £12,500; carried forward, after paying interim preference dividend, £68.

Herbert Morris, Limited.—Net profit, £51,687; brought in, £37,011; dividend on the ordinary shares of 10 per cent.; to reserve, £10,000; carried forward, £41,773.

Lambert Bros., Limited.—Net profit, £23,792; brought in, £94,897; carried forward, after payment of preference dividend, £104,939. A sum of £250,000, representing 5s. a share of the issued preference and ordinary capital as at June 30, 1932, has been repaid to the shareholders as from September 12 last, the issued share capital now amounting to £750,000. The directors propose in lieu of a dividend to make a distribution of 1s. a share on the 562,500 ordinary shares from realised proceeds of capital accretions.

Personal.

Mr. H. W. Keeble has been appointed Works Chemist and Metallurgist to Messrs. Craven Bros. (Manchester), Limited.

Col. G. Alfred Lewis, who for many years has been secretary of the Midland Counties Institution of Engineers, has been elected President in succession to Mr. R. F. Perry.

Sir Dugald Clerk, who was elected at the last general meeting of the Institution of Civil Engineers to succeed Sir Cyril Kirkpatrick as President, has decided not to take office. The Council of the Institution have received with regret intimation that considerations of health prevent Sir Dugald from assuming the office of President next month. In accordance with the rules, the Council have nominated Sir Murdoch Macdonald, M.P., the Vice-President, for the office, and a general meeting recently elected the new President.

At the annual meeting of the Central Board of the Shipbuilders' Employers' Federation, held in Edinburgh on October 21, Mr. J. B. Hutchison, of Messrs. Scotts' Shipbuilding & Engineering Company, Limited, Greenock, was elected President for the ensuing year. Mr. Maurice E. Denny, of Messrs. William Denny & Bros., Limited, Dumbarton, was elected a Vice-President to fill the vacancy caused by the election of Mr. Hutchison. In recent years Mr. Hutchison has been closely associated with the work of the Shipbuilders' Employers' Federation as a member of both the Central Board and the Executive Committee. He has taken a prominent part in the shipbuilding affairs on the Clyde, and in October, 1927, was elected President of the Clyde Shipbuilders' Association, an office which he held for two years.

Obituary.

Mr. J. A. Peace, managing director of Messrs. Cocker Bros., Limited, Fitzalan Works, Sheffield, died early last week.

Mr. G. H. Denison, managing director of Messrs. Samuel Denison & Son, Limited, Hunslet Foundry, Leeds, has died, aged 73.

Mr. James Wright Ferguson died at St. Clair, Elgin, in his 89th year on October 17. Mr. Ferguson was a member of one of the oldest Tain families, with a connection dating back well over a hundred and fifty years, when the local foundry owned by the family was a well-known undertaking in the district. Although residing in Elgin for a good many years, he maintained a close connection with the business and the burgh of Tain.

Mr. H. A. Ruck-Keene, Chief Engineer Surveyor of Lloyd's Register of Shipping, died on Friday, October 14, at the age of 66. Mr. Ruck-Keene was a Vice-President of the Institution of Naval Architects and of the Institute of Marine Engineers, and he was a member of the Institution of Civil Engineers, the Institute of Metals, the Iron and Steel Institute, the North-East Coast Institution of Engineers and Shipbuilders, and the British Association of Refrigeration. He was appointed an engineer surveyor to Lloyd's Register in 1890, and became chief engineer surveyor in 1921.

The death occurred at his residence in Glasgow, on October 15, of Mr. William Morrison, who was a noted figure in Clyde engineering circles. He was for many years manager of the London & Glasgow Engineering & Iron Shipbuilding Company, Limited, which was better known as "The Limited," as it was one of the first limited companies in the shipbuilding industry. After the firm was taken over by Messrs. Harland & Wolff, Mr. Morrison continued as engineering manager for about a year before retiring. Two of Mr. Morrison's sons are well-known consulting engineers in Glasgow, and a third is a director of Messrs. Swan, Hunter & Wigham Richardson, Limited, Wallsend-on-Tyne.

Accidents in American Foundries.—At a meeting of the Metals Section of the National Safety Council, held recently at Washington, D.C., it was stated that the 91 foundries which reported to the National Safety Council during each of the past three years had reduced their accidents from 48.20 per 1,000,000 man-hours for 1929 to 23.62 for 1931. But in severity rates they decreased only from 1.95 days lost per 1,000 man-hours in 1929 to 1.84 in 1931.

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Raw Material Markets.

The Tariff Board's decision to maintain the present duties on imported iron and steel, while, of course, leaving conditions as they were, has removed that uncertainty as to the future which has acted as a brake upon the iron and steel markets during the past few weeks. Buying as yet has shown no recovery, but it is now hoped that a greater proportion of business will result from the large number of inquiries that have been circulating during the past fortnight. Buying of pig-iron is limited, but there are signs of a revival of interest in the semis market. The demand for finished steel remains irregular and purchases are on the small side.

Pig-Iron.

MIDDLESBROUGH.—Buyers are showing an increasing interest in the market, but actual business has been difficult to arrange. The makers' efforts to increase sales of Cleveland iron in Scotland are not meeting with much success, while the export demand is very poor. It is also difficult to effect any expansion in sales to local foundries. The makers are consuming the bulk of the output in their own works. Except where special concessions are offered the price level is unchanged, fixed quotations being:—No. 1 Cleveland foundry iron, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

Slightly more activity is being witnessed in the East Coast hematite market, the fact not having escaped notice that there is now only 6d. difference between the quotations for mixed numbers and No. 3 Cleveland G.M.B. More inquiries are coming in and there has been a welcome increase in prompt orders. Quotations average 59s. per ton for mixed numbers and 59s. 6d. for No. 1 quality. The West Coast hematite market is reported to have turned the corner, the demand broadening from several districts. The output of the second furnace just blown in at Millom is being satisfactorily disposed of. Bessemer mixed numbers are strongly maintained at 66s. per ton, at works.

LANCASHIRE.—The demand from the foundries has not improved, in spite of slightly better conditions in one or two branches. The aggregate tonnage going into consumption remains at about the level of recent months, the amount of scrap used in this area being as large as ever. The cancellation of the Russian trade agreement may mean a considerable loss to the Manchester engineers, it remaining to be seen what attitude Russia will adopt. There has been no change in pig-iron quotations, Derbyshire, Staffordshire and North-East Coast brands being on the basis of 67s. per ton, including delivery in the Manchester zone, Northamptonshire at 65s. 6d., Derbyshire forge at 62s., Scottish foundry at from 83s. 6d. to 84s. and West Coast hematite at around 81s.

MIDLANDS.—Reports from this area give little cause for optimism. Only the light-castings foundries are showing any real activity, and even then at below the level that might be expected at this season of the year. A number of the furnaces are having to put considerable tonnages into stock each week. Prices are without change at 62s. 6d. for No. 3 Northants and 66s. for North Staffordshire, Derbyshire and Lincolnshire No. 3, delivered to Birmingham and Black Country stations. A little Scottish medium-phosphorus pig-iron continues to come into the Midlands, at from 83s. 6d. delivered, and from other sources medium-phosphorus iron is quoted at from 70s. to 80s. There are also a few transactions by ironfounders in the electrical trade for Cleveland No. 3 at 66s. No ordinary foundry iron is coming from the Continent at present.

SCOTLAND.—Business is very poor and consumers are only buying to satisfy their immediate needs. There is no change in the official minimum price of 67s. 6d. f.o.t. furnaces for No. 3 foundry iron, with an extra of not less than 2s. 6d. per ton for No. 1. No. 3 Middlesbrough is at 55s. 6d. at Falkirk and other English irons at about 54s., but the demand is very limited.

Coke.

There is only an irregular demand for foundry coke, the forward demand being particularly poor. The prices which have been operative for some months past are maintained. Delivered Birmingham district, 36s. 9d. to 38s. is quoted for best Durham fuel and from 30s. to 45s., according to analysis, for Welsh supplies.

Steel.

Business in steel material has been rather quiet, although there has been a certain amount of activity in the home market. The fluctuations in the exchange have made export business difficult and have put an end for the time being to any import transactions in Continental steel, as the sterling prices of many descriptions of foreign steel are now higher than the British quotations. The announcement of the continuance of the duties on steel for a period of two years has created more confidence, and there has been a fair amount of buying for general requirements in the home market. Business in semis has become rather brighter so far as the British makers are concerned, as Continental competition in the home market has practically ceased for the time being. Buying, however, is limited to hand-to-mouth parcels, as most consumers have good stocks on hand. Business in finished steel has not been active, but it is evident that the home producers are obtaining a larger share of the market than for many years past.

Scrap.

The weakest of the markets for scrap iron continue to be Scotland and South Wales, where the foundries are showing little sign of improving activity. In Scotland ordinary cast iron has been shaded to 37s. 6d. per ton, whilst in South Wales the quotation is being cut to 37s. per ton. In other districts the position remains unchanged. The amount of scrap iron being pressed upon the market continues to be large, and there can be no promise of alleviation until the present depression shows signs of lifting, especially in the shipping, textile, etc., industries.

Metals.

Copper.—Business with consumers remains limited. The official American quotation has now been reduced to 6 cents c.i.f. Europe, but business has been done in Europe at 5.225 cents per lb., the general quotation being 5.50 to 5.60 cents. United Kingdom consumers are wondering whether the latter level will be accepted as the "world price" at which the Empire producers are to be compelled to furnish adequate supplies under the Ottawa agreement, but it is anticipated that a more "economically just" level will be stipulated.

Closing quotations :—

Cash.—Thursday, £32 to £32 2s. 6d.; Friday, £31 15s. to £31 16s. 3d.; Monday, £31 7s. 6d. to £31 10s.; Tuesday, £31 11s. 3d. to £31 12s. 6d.; Wednesday, £30 12s. 6d. to £30 13s. 9d.

Three Months.—Thursday, £32 5s. to £32 6s. 3d.; Friday, £32 to £32 1s. 3d.; Monday, £31 10s. to £31 12s. 6d.; Tuesday, £31 13s. 9d. to £31 15s.; Wednesday, £30 15s. to £30 16s. 3d.

Tin.—British consumers are making a fair demand for this metal, particularly the tinplate interests. The outstanding feature of recent trading has been the contraction in the contango, owing to the readiness with which spot lots are taken up by the various interests operating on the market. The uncertainty of the exchange has been an unsettling factor.

Official closing prices :—

Cash.—Thursday, £151 17s. 6d. to £152 2s. 6d.; Friday, £151 15s. to £152; Monday, £151 5s. to £151 10s.; Tuesday, £153 10s. to £153 12s. 6d.; Wednesday, £152 2s. 6d. to £152 5s.

Three Months.—Thursday, £152 7s. 6d. to £152 10s.; Friday, £152 to £152 5s.; Monday, £151 12s. 6d. to £151 17s. 6d.; Tuesday, £153 15s. to £154; Wednesday, £152 10s. to £152 15s.

Spelter.—A little more interest is being shown by the British galvanising industry, but otherwise there is only a limited call for this metal, the price of which has, as in other cases, been affected by the fall in sterling. Production, however, is still being strictly limited, so that, presumably, the reduction of world stocks is still proceeding.

Daily fluctuations :—

Ordinary.—Thursday, £14 17s. 6d.; Friday, £14 17s. 6d.; Monday, £14 17s. 6d.; Tuesday, £15 3s. 9d.; Wednesday, £15 1s. 3d.

Lead.—Actual business in lead is still rather slow, but there has been an improvement in the number of inquiries from consumers, and altogether more interest is being generally taken in the market.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £11 15s.; Friday, £11 16s. 3d.; Monday, £11 15s.; Tuesday, £11 18s. 9d.; Wednesday, £11 12s. 6d.

Industrial Russia of 1932.

(*Concluded from page* 247.)

as they have placed their industrial undertakings upon a sound commercial basis and are in a position to deal with those problems which strike at the heart of a nation.

The so-called elimination of the capitalist is still a potent fetish with the rank and file of Soviet Russia, but sooner or later they will learn to appreciate that the Soviet method is a distinction without a real difference. Unless a works can produce an output compatible with the cost of its lay-out and equipment, the insolvency of that works is merely a question of time, though it may take longer to bring about national than individual bankruptcy.

The manufacture of special steels is also provided for in the Soviet plans. Prior to the Great War practically no special steels were manufactured in Russia, and even to-day Russia imports the major portion of her requirements. True, the Electrostal Works were partially erected during the war period and production was started just prior to the revolution; actually in 1917 about 13 tons of special steels were manufactured. The Zlatousk Steel Works, originally devoted to the production of iron and steel of commercial qualities, has during the past few years been largely reconstructed with a view to specialisation in high-grade steels. The Verkh-Isetsk Steel Works is also in process of reconstruction for the manufacture of special steels. The necessary alloys will be manufactured at the Cheliabinsk Works.

It cannot be denied that in pre-revolution days the rolling-mill plant in Russia was little more than a by-word, and very radical improvements have been effected, though, naturally, a great deal remains to be done if the mill plant is to be brought anywhere near into line with the development of the iron and steel industries. The total output of the Russian mills was stated to be 3,500,000 tons in 1913, whilst the writer is informed that the output for the first six months of the present year was 2,224,000 tons, as compared with 1,917,000 tons for the corresponding period of last year.

Two cogging mills were installed in 1931. A rail mill is to be completed and got into production by the end of the year at Kuznetsk. It is said to be designed for rolling 350,000 tons of rails per year.

Silica in Iron Ores.—The following are the conclusions contained in a Paper entitled "Evaluation of 1 per cent. Silica in Iron Ores," read by Mr. R. H. Sweetser before the American Institute of Mining and Metallurgical Engineers:—(1) An increase in silica contents in the ore mixture does not necessarily mean increased coke consumption, nor increased cost of pig-iron. (2) A decrease in iron contents in the ore mixture results in an increase in slag volume. (3) When the slag volume is small the slag must be more basic in order to obtain low sulphur in the pig-iron (*i.e.*, below 0.025 per cent.). (4) It is not necessary to slow down the furnace in order to make high-silicon pig-iron. (5) A furnace should burn approximately the same amount of coke per day regardless of the kind of iron being made. (6) High iron in the ore mixture and high carbon in the coke are the two controlling factors—increase in SiO_2 is secondary.

Sterling

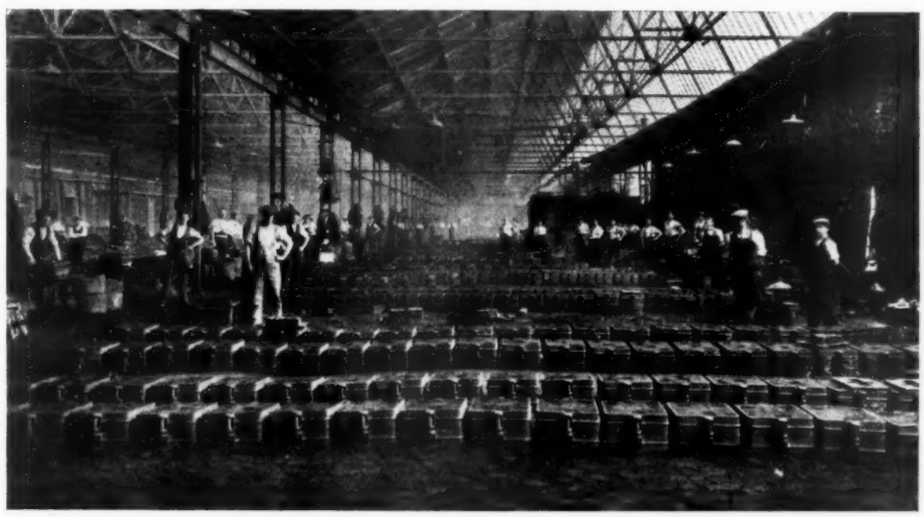
MOULDING BOXES

Stand up to the exacting Requirements of the Modern Foundry

because

They are made from Rolled Steel

Over 2,500 pairs of STERLING BOXES are in daily use in the Foundry of Messrs. THOS. L. HALE (Tipton) LTD., DUDLEY PORT, Malleable Ironfounders.



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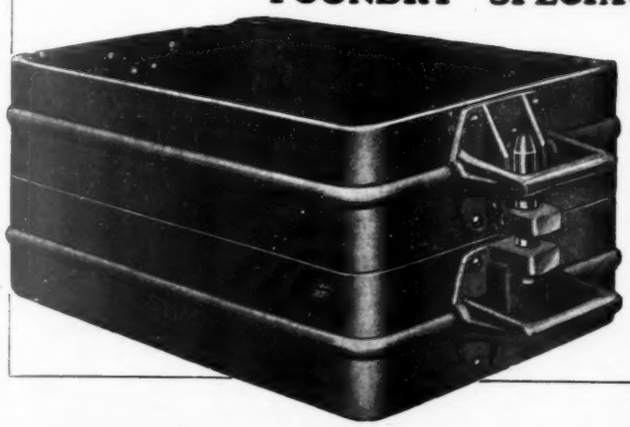
FOUNDRY SPECIALTIES LTD.,

BEDFORD.



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YOU CAN RELY ON THE NAME

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	30	12	6
Three months	30	15	0
Electrolytic	35	0	0
Tough	33	5	0
Best selected	33	15	0
Sheets	65	0	0
India	44	15	0
Wire bars	36	10	0
Do., Nov.	36	15	0
Do., Dec.	37	0	0
Ingot bars	36	10	0
H.C. wire rods	39	5	0
Off. av. cash, September	35	0	7 3/4
Do., 3 mths., September	35	1	1 7/11
Do., Sttlmnt., September	35	0	6 9/11
Do., Electro, September	38	13	2 5/11
Do., B.S., September	37	4	2
Do., wire bars, September	39	0	0
Solid drawn tubes			10d.
Brazed tubes			10½d.
Wire			7d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7¾d.
Wire	7¾d.
Rolled metal	7½d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN.

	£	s.	d.
Standard cash	152	2	6
Three months	152	10	0
English	152	12	6
Bars	157	5	0
Straits	159	5	0
Australian	157	10	0
Eastern	157	17	6
Banca	160	10	0
Off. av. cash, September	152	16	3
Do., 3 mths., September	154	7	7 4/11
Do., Sttlmt., September	152	16	1 7/11

SPELTER.

	£	s.	d.
Ordinary	15	1	3
Remelted	15	10	0
Hard	13	5	0
Electro 99.9	17	10	0
English	16	2	6
India	14	5	0
Zinc dust	22	0	0
Zinc ashes	2	5	0
Off. aver., September	15	10	8 3/4
Aver. spot, September	15	9	1 1/11

LEAD.

	£	s.	d.
Soft foreign ppt.	11	12	6
Empire	12	8	9
English	13	10	0
Off. average, September	13	4	8 1/2
Average spot, September	13	2	5 7/8

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whse.	23	0	0
Rods	27	0	0
Boiler plates	23	0	0
Battery plates		—	

ANTIMONY.

	£	s.	d.		£	s.	d.
English	35	0	0	to	42	10	0
Chinese					23	10	0
Crude					16	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	9	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 0 0
45/50%	£13 15 0
75%	£19 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	10d. lb.
Ferro-phosphorus, 20/25%	£20 0 0
Ferro-tungsten—	
80/85%	1/7½ lb.
Tungsten metal powder—	
98/99%	1/10½ lb.
Ferro-chrome—	
2/4% car.	£34 5 0
4/6% car.	£25 15 0
6/8% car.	£24 10 0
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£36 10 0
Max. 1% car.	£42 12 6
Max. 0.70% car.	£43 17 6
70% carbon-free	1/- lb.
Nickel—80/99.5%	£250 to £255
"F" nickel shot	£225 0 0
Ferro-cobalt	7/9 lb.
Aluminium 98/99%	£100 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¾ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	1	17	0	to	1	18	0
Bundled steel and shrngs.	1	14	0	to	1	17	0
Mixed iron and steel	1	14	0	to	1	15	0
Heavy cast iron	1	17	0	to	1	19	0
Good machinery			2	5	0		
Cleveland—							
Heavy steel			1	14	0		
Steel turnings			1	7	6		
Cast-iron borings			1	2	6		
Heavy forge			2	10	0		
W.I. piling scrap			2	2	6		
Cast-iron scrap	1	15	0	to	1	16	0
Midlands—							
Light cast-iron scrap			1	15	6		
Heavy wrought iron			2	5	0		
Steel turnings, f.o.r.			0	19	0		
Scotland—							
Heavy steel			1	12	6		
Ordinary cast iron			1	17	6		
Engineers' turnings			1	8	0		
Cast-iron borings			1	10	0		
Wrought-iron piling			1	19	0		
Heavy machinery			2	4	6		

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	26	0	0
Brass	17	0	0
Lead (less usual draft)	10	10	0
Tea lead	9	0	0
Zinc	8	10	0
New aluminium cuttings	72	0	0
Braziery copper	23	0	0
Gunmetal	22	0	0
Hollow pewter	82	0	0
Shaped black pewter	65	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	59/6
Hematite M/Nos.	59/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	70/-
d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs No. 4 forge*	61/-
No. 3 fdry.*	66/-
Shrops basic	—
Cold blast, ord.	—
roll iron	—
Northants forge*	57/6
fdry. No. 3*	62/6
fdry. No. 1*	65/6
Derbyshire forge*	61/-
fdry. No. 3*	66/-
fdry. No. 1*	69/-
basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	70/-
No. 3	67/6
Hem. M/Nos. d/d	67/6
Sheffield (d/d district)—	
Derby forge	58/6
fdry. No. 3	63/6
Lincs forge	—
fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	83/6 to 84/6
Clyde, No. 3	83/6 to 84/6
Monkland, No. 3	83/6 to 84/6
Summerlee, No. 3	83/6 to 84/6
Eglinton, No. 3	83/6 to 84/6
Gartsherrie, No. 3	83/6 to 84/6
Shotts, No. 3	83/6 to 84/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	0	0	to	9	15	0
Nut and bolt iron	7	15	0	to	8	10	0
Hoops	10	10	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to	12	0	0
Bolts and nuts, ¾ in. × 4 in.					12	0	0
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	8	7	6	to	9	5	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)			6	15	0	& up.	
Flats—8 in. wide and over					8	12	6
under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates					12	0	0
Hoops (Staffs)					9	10	0
Black sheets, 24g.					9	5	0
Galv. cor. shts.					11	5	0
Galv. flat shts.					11	15	0
Galv. fencing wire, 8g. plain					14	0	0
Billets, soft	4	17	6	to	5	7	6
Billets, hard	6	12	6	to	7	2	6
Sheet bars	4	12	6	to	5	2	6
Tin bars	4	12	6	to	4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	11½d.
Rods	10½d.
Tubes	16½d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	13.84
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.39
Bessemer	16.89
Malleable	16.39
Grey forge	16.39
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	40.00
Billets	26.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.55
Sheets, black, No. 24	2.20
Sheets, galv., No. 24	2.85
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
furnace	16/- to 16/6
Durham and Northumberland—	
foundry	21/- to 25/-
furnace	12/- to 12/6
Midlands, foundry	—
furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/-
	28×20 "	32/-
	20×10 "	23/-
	18¾×14 "	16/7½
C.W.	20×14 "	13/6 to 13/9
	28×20 "	—
	20×10 "	—
	18¾×14 "	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars-hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Oct.	20 ..	32	0	0	dec.	6/3
,,	21 ..	31	15	0	,,	5/-
,,	24 ..	31	7	6	,,	7/6
,,	25 ..	31	11	3	inc.	3/9
,,	26 ..	30	12	6	dec.	21/3

Electrolytic Copper.

		£	s.	d.		
Oct.	20 ..	36	0	0	dec.	10/-
,,	21 ..	35	15	0	,,	5/-
,,	24 ..	35	10	0	,,	5/-
,,	25 ..	35	10	0	No change	
,,	26 ..	35	0	0	dec.	10/-

Standard Tin (cash).

		£	s.	d.		
Oct.	20 ..	151	17	6	dec.	25/-
,,	21 ..	151	15	0	,,	2/6
,,	24 ..	151	5	0	,,	10/-
,,	25 ..	153	10	0	inc.	45/-
,,	26 ..	152	2	6	dec.	27/6

Tin (English ingots).

		£	s.	d.		
Oct.	20 ..	152	10	0	dec.	45/-
,,	21 ..	152	10	0	No change	
,,	24 ..	151	15	0	dec.	15/-
,,	25 ..	154	0	0	inc.	45/-
,,	26 ..	152	12	6	dec.	27/6

Spelter (ordinary).

		£	s.	d.		
Oct.	20 ..	14	17	6	dec.	1/3
,,	21 ..	14	17	6	No change	
,,	24 ..	14	17	6	,,	,,
,,	25 ..	15	3	9	inc.	6/3
,,	26 ..	15	1	3	dec.	2/6

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Oct.	20 ..	17	7	6	inc.	2/6
,,	21 ..	17	7	6	No change	
,,	24 ..	17	7	6	,,	,,
,,	25 ..	17	12	6	inc.	5/-
,,	26 ..	17	10	0	dec.	2/6

Zinc Sheets (English).

		£	s.	d.		
Oct.	20 ..	24	10	0	No change	
,,	21 ..	24	10	0	,,	,,
,,	24 ..	24	10	0	,,	,,
,,	25 ..	24	10	0	,,	,,
,,	26 ..	24	10	0	,,	,,

Lead (English).

		£	s.	d.		
Oct.	20 ..	13	10	0	dec.	5/-
,,	21 ..	13	10	0	No change	
,,	24 ..	13	10	0	,,	,,
,,	25 ..	13	15	0	inc.	5/-
,,	26 ..	13	10	0	dec.	5/-

AVERAGE MONTHLY PRICES OF IRON HOOPS.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 5 0	6 10 0	6 3 0
1897	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 8
1898	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	7 0 0	6 11 6
1899	7 0 0	7 0 0	7 0 0	7 0 0	7 12 6	10 12 6	8 12 6	8 12 6	8 12 6	9 2 6	9 7 6	9 17 6	8 2 9
1900	9 17 6	10 7 6	10 7 6	10 7 0	10 12 6	7 12 6	10 12 6	10 12 6	10 12 6	9 17 6	9 2 6	9 2 6	10 3 8
1901	9 2 6	8 2 6	8 2 6	7 12 6	7 12 6	7 12 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 11 2
1902	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1903	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 0
1904	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1905	6 17 6	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 2 6	7 2 6	7 2 6	7 7 6	7 0 0	7 7 6	7 2 0½
1906	7 10 0	7 17 6	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 7 6	7 15 1½
1907	8 7 6	8 7 6	8 7 6	8 7 0	8 7 6	8 7 6	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 0 0	8 7 1
1908	8 0 0	7 10 0	7 10 0	7 10 6	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 6 8
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0
1910	7 1 10½	7 6 3	7 7 6	7 7 0	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 6 3	7 5 0	7 5 0	7 6 5
1911	7 5 0	7 5 0	7 5 6	7 5 6	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 8 9	7 10 0	7 10 0	7 6 2½
1912	7 12 6	7 12 6	7 12 6	7 15 0	7 15 0	8 2 6	8 2 6	8 2 6	8 12 6	8 12 6	8 12 6	8 15 0	8 2 3½
1913	8 17 6	8 17 6	8 17 6	8 17 0	8 17 6	8 17 6	8 17 6	8 7 6	8 7 6	8 7 6	8 7 6	7 17 6	8 12 6
1914	7 17 6	7 17 6	7 17 6	7 13 9	7 12 6	7 12 6	7 12 6	9 2 6	9 2 6	9 2 6	9 2 6	9 2 6	8 6 4½
1915	9 3 6	9 18 1	10 7 6	10 16 6	10 17 6	13 2 6	13 2 6	13 2 6	13 7 6	14 2 6	15 2 6	15 18 6	12 10 1
1916	17 2 6	17 2 6	17 2 6	17 6 3	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 6 1
1917	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1918	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1919	17 2 6	17 2 6	17 2 6	17 2 6	24 6 3	24 6 3	24 6 3	25 9 0	26 7 6	26 7 6	26 7 6	26 17 4	22 14 9
1920	28 0 0	28 12 6	33 15 0	35 5 0	35 15 10	38 17 6	38 17 6	38 17 6	38 17 6	38 17 6	36 17 6	36 17 6	35 14 9
1921	29 1 3	23 5 0	21 12 6	20 0 0	20 0 0	20 0 0	17 5 0	15 0 0	14 4 0	13 15 0	13 10 0	12 18 0	17 5 10
1922	16 5 0	15 13 9	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	13 4 6½
1923	14 0 0	15 0 0	15 0 0	15 0 0	15 6 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 16 0	14 15 0	14 18 3½
1924	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 13 9	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 12 4½
1925	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1926	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1927	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	12 10 0	12 10 0	14 3 4
1928	12 10 0	12 7 6	12 0 0	11 13 6	11 15 0	11 12 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 14 10½
1929	11 10 0	11 10 0	11 10 0	11 10 0	11 9 0	11 5 0	11 5 0	11 5 0	11 5 0	11 2 0	11 0 0	11 0 0	11 5 11
1930	11 0 0	11 0 0	11 0 0	10 16 3	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 16 4½
1931	10 15 0	10 15 0	10 15 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 11 3
1932	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	—	—	—	—

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